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Education Department Bulletin

Published fortnightly by the University of the State of New York

Entered as second-class matter June 24, 1908, at the Post Office at Albany, N. Y., under the act of July 16, 1894

No. 490 ALBANY, N. Y. MARCH 1, 1911

New York State Museum

JOHN M. CLARKE, Director
EPHRAIM PORTER FELT, State Entomologist

Museum Bulletin 147

26th REPORT OF THE STATE ENTOMOLOGIST

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1910

FRANKLIN BUREAU OF AMERICAN ETHNOLOGY, 1911 LIBRARY

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STATE OF NEW YORK

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New York State Education Department
Science Division, December 21, 1910

Hon. Andrew S. Draper LL.D.
Commissioner of Education

DEAR SIR: I have the honor to communicate herewith for publication as a bulletin of the State Museum the Annual Report of the State Entomologist, for the fiscal year ending September 30, 1910.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 22d day of December 1910

A. S. Draper

Commissioner of Education

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New York State Museum

John M. Clarke, Director

Ephraim Porter Felt, State Entomologist

Museum Bulletin 147

26th REPORT OF THE STATE ENTOMOLOGIST, 1910

To John M. Clarke, Director of Science Division

I have the honor of presenting herewith my report on the injurious and other insects of the State of New York for the year ending October 15, 1910.

The past season has been remarkably quiet so far as unusual outbreaks of injurious insects are concerned. The entomologist was exceptionally fortunate in discovering a colony of pedogenetic larvae, presumably those of Miastor americana. These extremely peculiar forms were previously unknown in this country and have been studied by only a few Europeans. A summarized account of these interesting larvae is given in an appendix.

Fruit tree pests. The experimental work with the codling moth was continued the present season under more diverse conditions, and data which will be of great value in the practical control of this species, was secured. The experiments were conducted in the orchards of W. H. Hart, Poughkeepsie; C. R. Shons, Washingtonville and William Hotaling, Kinderhook. Great pains were taken to secure an ample number of trees likely to produce a nearly uniform amount of fruit. Each plot, as last year, except in the case of Mr Hotaling's orchard, consisted of 42 trees, the fruit from the central six alone being counted. Comparisons were made to ascertain the relative efficacy of one spray given just after the blossoms dropped, with this treatment supplemented by a second application

about three weeks later. The unusual abundance of the codling moth the past season renders the data secured of exceptional value because they show the possibilities under very adverse conditions. Assistant State Entomologist Young aided in the field work and was responsible in large measure for the computation of the tabulated data. These experiments and their application are discussed on subsequent pages.

The San José scale is still very destructive, especially to peach trees, though our progressive orchardists have comparatively little difficulty in controlling it. A lime-sulfur wash, particularly that known as the concentrated wash, either homemade or commercial, has proved very satisfactory, as a rule, in checking this pest. There was complaint of injury by the cherry maggot in the Hudson valley and an investigation of the pest and methods of controlling it was inaugurated. The cherry and pear slug was exceptionally abundant in this region and also in the western part of the State. The pear psylla was somewhat numerous in the lower Hudson valley and reports of serious injuries were received from certain sections in the western part of the State.

The work of a new apple pest which may be known as the lined red bug (Lygidea mendax Reut.) was observed in the Hudson valley. This insect occurs in early spring, lives upon the more tender terminal leaves and, under favorable conditions, may inflict considerable injury.

Shade tree pests. The injurious work of various species has been brought to our notice. The more important of the shade tree pests is the elm leaf beetle, a well known form which has been exceedingly abundant on Long Island, throughout the Hudson valley and in certain cities in the western part of the State. The sugar maple borer has been unusually numerous on the trees of Fulton, Oswego county, destroying or practically ruining a number of magnificent trees. The cottony maple scale has been somewhat abundant in the lower Hudson valley, while the injurious work of the false maple scale was observed in several localities in the vicinity of New York city.

Forest insects. The snow-white linden moth, a pest which has been very destructive in the Catskills for the past three years, was abundant in limited localities last season and its flight in small numbers was observed in various places. A series of outbreaks by another leaf feeder was reported from several localities. They were due to the operations of a green, white-striped caterpillar

(Xylina antennata) frequently designated as the green fruit worm. The destructive work of the hickory bark beetle, noted in a preceding report, has been continued. An unusual outbreak was that of Abbott's sawfly, a false caterpillar which stripped or nearly defoliated many white pines in the foothills of the Adirondacks. The spruce gall aphid has continued to be abundant and injurious on Norway spruce, in particular. It is interesting to record the discovery of another species of gall aphid, new to the State, occurring upon the Colorado blue spruce. The above noted insects have been the subject of correspondence and, in some instances, of field investigations during the past season.

Gipsy and brown tail moths. Much interest was aroused early in 1909 by the finding of thousands of winter nests of the brown tail moth on many shipments of French seedlings. A number of such nests occurred on shipments received in 1910, though the pests were not so abundant as during the preceding year. The careful inspection of the stock appears to have prevented this insect from becoming established in the State. There is much more danger of this moth being brought into New York State on shipments of full grown nursery stock originating in infested American territory than there is of its being introduced with imported seedlings. It has been found necessary to give considerable time to the determination of remains of caterpillars, cocoons and egg masses in order to be certain that none of these fragments on nursery stock indicated the presence of either the gipsy or brown tail moth. The mounting of such fragments has devolved upon Miss Hartman.

A personal investigation of conditions in eastern Massachusetts shows that no pains are being spared to prevent the dissemination of either the gipsy or the brown tail moth. Particular attention has been given to keeping the property abutting on the principal highways free from the pests so as to eliminate in large measure the danger of their being carried by vehicles of any kind. There has been, however, some extension of the territory occupied by these two pests. The gradual spread of these insects appears to be inevitable, though the utmost care is taken in the treatment of the outlying colonies. It is gratifying to state that the serious infestation recently discovered at Wallingford, Conn. has been handled in such a satisfactory manner that only a very few specimens rewarded a week's careful search by a gang of fifteen men. An examination of the work with parasites showed that no stone was being left unturned in an effort to find, rear and liberate a large number of

efficient enemies of these pests. The entomologist would emphasize once more the grave danger of bringing either one or both of these pests into the State on nursery stock originating in the infested area, and would call attention to the great desirability of promptly exterminating any isolated colonies which might be found in the near future.

House fly. The popular interest in the control of this pest has continued and bids fair to result in important and far-reaching sanitary changes. The demand for information along these lines speedily exhausted the edition of Museum Bulletin 129 on the *Control of Household Insects* and necessitated its republication in an extended and revised form as Museum Bulletin 136 entitled: *The Control of Flies and Other Household Insects.* The entomologist has been called upon to give a number of popular lectures upon this insect and has made personal examinations of conditions in several localities, giving special attention to situations favorable for the production of flies in cities and villages.

Gall midges. Our studies of this extensive and interesting group have been continued and the results are now in manuscript. This publication will describe fully some 800 species, 441 having been reared. The tabulation of midge galls, made with the assistance of Miss Hartman, shows that we know some 538 species representing 44 genera and living at the expense of some 177 plant genera referable to 66 plant families. In addition to the above, there are some 5 species reared from unknown plants and 11 species belonging to 3 genera known to be zoophagous.

A number of new species have been reared during the year. Miss Cora H. Clarke of Boston, Mass. has continued collecting and forwarding to us excellent series of galls from which we were able to rear several previously unknown species. The care of this material has devolved largely upon assistant D. B. Young and Miss Hartman. The latter has also made a large number of microscopic mounts of these fragile forms.

Miscellaneous. The entomologist spent nearly six weeks in Europe, giving special attention to museum methods, shade and forest tree insects and the gall midges. Collections were studied in the following institutions: British Museum of Natural History, London; the Universities of Oxford and Cambridge; the Tropical School of Medicine, Liverpool; the zoological gardens at Antwerp; the Royal Museum of Natural History at Brussels; the botanical gardens of Ghent; Museum of Natural History and also the ento-

mological station, both of Paris; the University at Zurich; the exceptionally valuable collection of forest insects in the forestry school at Munich; the natural history collections in the Senckenberg Museum at Frankfurt; the Winnertz collections in the University of Bonn; the Museum of Natural History, Berlin, and the Museum of Natural History at Hamburg. In addition, the entomologist spent several days with Prof. J. J. Kieffer of Bitsch, Germany, studying his exceptionally valuable collection of Cecidomyiidae, and a day with Prof. E. H. Rübsaamen at Remagen, Germany, which was devoted largely to examining his numerous excellent drawings and a discussion of the classification of this group. A portion of a day was spent with Oberforster H. Strohmeyer of Münster, Germany, studying his excellent collection of Scolytidae, while another day was passed with Oberforster Karl Philip at Sulzberg obtaining first-hand information of forestry methods as practised in Germany.

Publications. Numerous brief, popular accounts dealing with injurious insects have been prepared by the entomologist for the agricultural and local press, besides a few more technical papers for scientific publications. A revision of Museum Bulletin 129, as noted above, was issued during the year, while the report for 1909 appeared July last. A tabulation of the midge galls known to occur upon several plants was published in August under the title of *Gall Midges of Aster, Carya, Quercus and Salix.*

Collections. A most valuable addition to the collections was secured through the generosity of Prof. J. J. Kieffer, of Bitsch, Germany, who kindly donated to the museum a number of his generic types of European gall midges. These have been carefully mounted and are now accessible to students in the group. A fine series of Italian midge galls was secured by exchange with Dr Mario Bezzi. These were carefully arranged and labeled by Miss Hartman. Miss Cora H. Clarke, as in preceding years, has contributed some valuable biological material, mostly insect galls.

The arrangement and classification of the collection has been pushed as rapidly as possible, though it should be remembered that, with the limited office staff, it is practically impossible to keep the collections properly classified, while the securing of extremely desirable additional material must of necessity proceed slowly. The restrictions due to a small staff will become more apparent with the occupancy of quarters in the new building, accompanied by the obligation of maintaining a larger exhibit. The school teachers of

Albany, Troy and presumably other near-by localities are making extensive use of our exhibit collections in connection with the regular school work. It is the aim of the Department to have a representative collection of the species occurring in the State, though the assembling of such means the work of years.

The nearly completed monograph on the gall midges shows that the State collections in this family will far exceed anything that can be assembled elsewhere for some years to come. It will always be exceptionally valuable because of the very large series of generic types or cotypes. Assistant State Entomologist Young has identified and arranged the Conopidae, besides doing much miscellaneous work in classifying insects collected during the year and identifying species sent in for name. A number of Hemiptera have been very kindly determined by our well known authority in this group, Mr E. P. Van Duzee of Buffalo. Miss Hartman has also assisted in the arrangement of the collection and has reared and spread a number of specimens.

The value of the exhibit collections will be greatly enhanced when the fine series of plant groups, designed for the exhibition of insects in their natural environment in the new Educational Building, has been completed. The wax work for four of these groups has been delivered and it is planned to complete the remainder next year. Several excellent models representing injurious insects are now on exhibition and more should be secured, preferably made to order, since only a few can be purchased in the market, while no one has attempted to prepare models of many forms which could be exhibited in this manner to very great advantage.

Nursery inspection. There has been close cooperation with this phase of the work conducted by the State Department of Agriculture. Numerous specimens of both native and foreign insects have been submitted to this office for name, and the entomologist frequently consulted in regard to various problems. This work, while consuming much time and often necessitating identifications of minute forms, like scale insects or the recognition of species by fragments or the comparatively unknown early stages, is very important, since the treatment of large shipments must depend in great measure upon our findings.

Office matters. The general work of the office has progressed in a satisfactory manner, the assistant State entomologist being in charge of the office and responsible for the correspondence and

other matters during the absence of the entomologist in Europe and while away on vacation. Miss Hartman, in addition to matters noted above, has rendered material assistance in bibliographic work and in translating from German, French and Italian works. Numerous specimens have been received during the year for identification and many inquiries made concerning injurious forms. 1445 letters, 37 postals, 417 circulars, 1475 packages were sent through the mails and 44 packages were shipped by express.

General. The work of this office has been greatly facilitated, as in past years, by the identification of certain species through the courtesy of Dr L. O. Howard, chief of the Bureau of Entomology, U. S. Department of Agriculture, and his associates. Several correspondents have aided materially in securing valuable specimens of one kind or another, and, as heretofore, there has been a most helpful cooperation on the part of all interested in the work of this office.

Respectfully submitted

EPHRAIM PORTER FELT

State Entomologist

Office of the State Entomologist, October 15, 1910

INJURIOUS INSECTS

CODLING MOTH

Carpocapsa pomonella Linn.

The apple worm, or larva of the codling moth, is such a common pest that comparatively few appreciate the losses caused by its operations, and altogether too many regard it as a pest which it is almost useless to combat. This latter notion is a very erroneous one. There is abundant data to prove not only the possibility, but the practicability, of controlling this insect in a very satisfactory manner. This is shown in a very striking way by the experiments conducted last year. Even one thorough application resulted in the production of nearly 99 per cent of worm-free fruit, while check trees did not produce quite 73 per cent of sound fruit. These experiments were continued the present season for the purpose of testing more thoroughly and under varying conditions the relative value of one or more sprays for the control of this serious pest.

General observations. The season of 1910 has been remarkable for the development of a large second brood and a consequent prevalence of wormy apples. The work of this pest was very evident in Genesee county as well as in the Hudson valley, and in some unsprayed orchards over 50 per cent of the fruit had been injured by the apple worm. May 30th there was a severe hail storm in sections of the Hudson valley, and an examination of the wormy fruit showed that from 50 to 60 per cent of the apple worms had entered at points injured by the hail. Cacoecia larvae were rather prevalent in one orchard and their operations were very frequently followed by codling moth larvae entering at such places. Moreover, badly rusted, rough spots on the fruit were also favorite points of attack. Comparative freedom from codling moth injury was observable in orchards where pigs or sheep had been allowed to run, this being especially true if the animals had been pastured in the orchards for several years, even in those where there was no spraying. One codling moth larva was found spun up in a slight depression on the under side of an apple resting on loose soil, and

another had prepared a similar retreat for the winter on an apple before it had dropped from the tree.

Life history and habits. Before discussing the experimental work of the season we will briefly summarize the life history of this species. The apple worm, as is well known, winters in a tough, silken cocoon, usually found under the rough bark of trees. The advent of warm weather in spring, which in New York means late April and early May, is followed by the caterpillars transforming within their silken retreats to pupae, and a week or ten days after the blossoms drop the moths commence to emerge and continue to appear throughout the greater part of June. The minute, whitish eggs are deposited largely upon the leaves, though a number may be found on the young fruit. These hatch in about a week and as a consequence the young apple worms of the first brood may be entering the small apples from early in June to nearly the end of the month, or even later. The caterpillars require about four weeks to complete their growth, at which time they desert the fruit, wander to a sheltered place, spin a cocoon, transform to pupae and in about two weeks, namely the very last of July or in August, another brood of moths appears. These in turn deposit eggs which hatch in due time and the young larvae usually enter the side of the fruit. Two broods appear to be the rule in the northern fruit-growing sections of the United States, though some investigators claim a third in the southwest.

Experimental work. It was planned the present season to test, under varying conditions, the relative efficacy of but one spray given just after the blossoms fall, compared with other plots where the application just described was followed by a second about three weeks later, designed to destroy the codling moth larvae just as they are hatching, and a third plot where but one spraying was given about three weeks after the blossoms fell. This plot was designed to show the relative efficacy between the treatment at this time, which is markedly out of season, and the time applications are usually made, namely just after the bloom falls.

Series 1. This series of experiments were conducted in a young orchard belonging to Mr W. H. Hart of Arlington, near Poughkeepsie and close to Briggs Station on the Hopewell branch of the Central New England Railroad. The orchard is on a moderately high hill, the trees being thrifty, about 16 years old, 16 to 19 feet

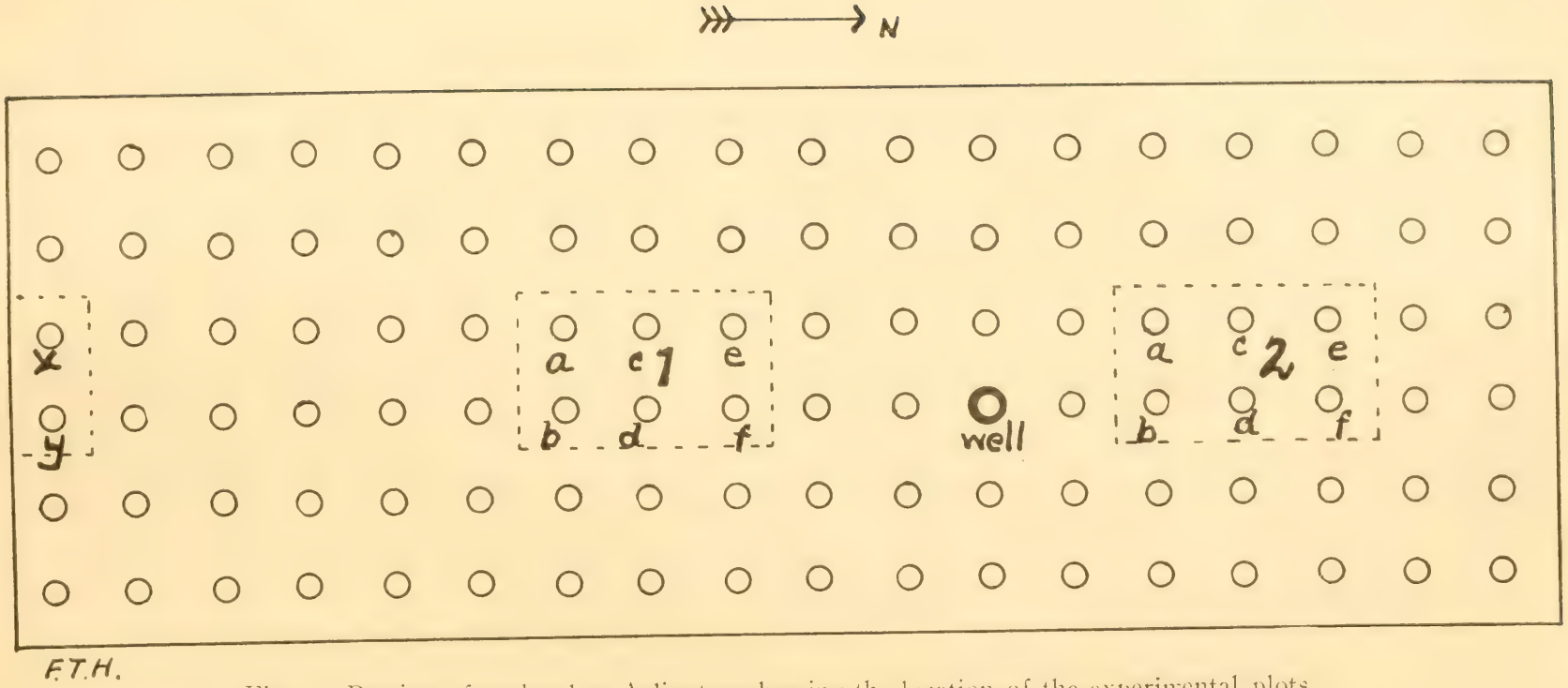

Fig. 1 Portion of orchard at Arlington showing the location of the experimental plots

high and 30 feet apart. The actual experimental trees were northern spy. Each plot consists of 42 trees, six trees in a row one way and seven in a row the other way, the central six being the actual experimental trees. These were carefully selected for uniformity in size, fruitage and infestation. There was a large crop of Baldwin apples in this orchard last year and some of the northern spys produced a fair yield. The check trees of the two plots in this orchard were located in the same north and south rows of trees near the western edge of the orchard, and were some little distance north of the road. Plots 1 and 2 were still further north. These two plots were thoroughly sprayed May 12, 1910 with seven pounds of arsenate of lead (15 per cent arsenic oxide) to each 150 gallons of spray, together with one gallon of a homemade concentrated lime-sulfur wash (Cordley formula, testing probably from 30 to 31° Baumé) to each 25 or 30 gallons of spray. The day was dry, nearly quiet and conditions were almost ideal. The pressure was maintained at from 100 to 150 pounds, Friend nozzles being employed and 150 gallons of spray sufficing for about 105 trees. All of the spraying was from the ground, the hose being tied to poles and the nozzles set at an angle so as to discharge almost directly into all the blossoms. The application was sufficiently thorough to cover practically all of the foliage in a very uniform manner. The trees were fairly well fruited and had just completed blossoming.

The second application was made on plot 2 June 2d. The day was cloudy, with a strong southwest wind and, as a consequence, the spray was applied from only one side, the eastern portion of the trees not being well covered, though special attention was given to the center where the greater portion of the fruit was located. The formula for the spray was practically the same as in the preceding application; 140 gallons were necessary to spray the plot of 42 trees. The fruit was in fine condition and the foliage had made excellent growth since the earlier application, which was plainly evident. At this time there were no signs of codling moth work.

An examination of this orchard June 30th showed a very gratifying condition. The check trees were in excellent foliage and already exhibited a markedly greater codling moth infestation. Plot 1, which received but one spraying, showed practically no wormy fruit and no signs of injury to the foliage. The same was true of plot 2 which was sprayed twice.

The fruit was picked up from under these trees and carefully classified August 23d and September 12th, the remainder being picked October 6th. The condition of the fruit on this latter date was most excellent, the color being fine, the surface smooth and a very high percentage with few defects. A tabulation of the entire data is given below.

Series 1, plot 1

			CLEAN FRUIT		WORMY FRUIT						
TREE	DATE	TOTAL FRUIT	Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 23	9	6	.....	3	.....	.....	.....	3	3	.....
	Sept. 12	6	4	.....	2	.....	.....	.....	2	2	.....
	Oct. 6	148	135	.....	13	.....	.....	3	10	3	1
		163	145	88.95	18	11.05	.....	3	15	8	1
B	Aug. 23	1	1	.....	.....	.....	.....	.....	.....	.....	.....
	Sept. 12	8	5	.....	3	.....	.....	.....	3	3	.....
	Oct. 6	105	99	.....	6	.....	1	2	3	2	1
		114	105	92.10	9	7.90	1	2	6	5	1
C	Aug. 23	12	4	.....	8	.....	.....	1	7	7	.....
	Sept. 12	22	13	.....	9	.....	.....	1	8	9	.....
	Oct. 6	409	382	.....	27	.....	5	7	15	6	.....
		443	399	90.07	44	9.93	5	9	30	22	.....
D	Aug. 23	14	7	.....	7	.....	.....	.....	7	7	.....
	Sept. 12	20	13	.....	7	.....	3	.....	4	6.	.....
	Oct. 6	593	563	.....	30	.....	1	2	27	3	.....
		627	583	92.98	44	7.02	4	2	38	16	.....
E	Aug. 23	5	1	.....	4	.....	.....	.....	4	4	.....
	Sept. 12	6	6	.....	.....	.....	.....	.....	.....	.....	.....
	Oct. 6	160	139	.....	21	.....	4	3	14	5	1
		171	146	85.38	25	14.62	4	3	18	9	1
F	Aug. 23	12	3	.....	9	.....	.....	.....	9	8	.....
	Sept. 12	11	8	.....	3	.....	.....	.....	3	3	.....
	Oct. 6	298	275	.....	23	.....	2	2	19	12	.....
		321	286	89.09	35	10.91	2	2	31	23	.....
	Grand total	1839	1664	90.48	175	9.52	16	21	138	83	

Series 1, plot 2

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 23	12	11	.....	1	.....	.....	.....	1	1	.....
	Sept. 12	9	9	.....	.....	.....	.....	.....	.....	.....	.....
	Oct. 6	441	414	.....	27	.....	4	.....	23	3	.....
		462	434	93.93	28	6.07	4	.....	24	4	.....
B	Aug. 23	3	2	.....	1	.....	.....	.....	1	1	.....
	Sept. 12	5	3	.....	2	.....	.....	.....	2	2	.....
	Oct. 6	362	347	.....	15	.....	.....	.....	15	4	.....
		370	352	95.14	18	4.86	.....	.....	18	7	.....
C	Aug. 23	2	1	.....	1	.....	.....	.....	1	1	.....
	Sept. 12	9	8	.....	1	.....	.....	.....	1	.....	.....
	Oct. 6	218	215	.....	3	.....	1	.....	2	.....	.....
		229	224	97.81	5	2.19	1	.....	4	1	.....
D	Aug. 23	12	7	.....	5	.....	.....	.....	5	5	.....
	Sept. 12	14	12	.....	2	.....	.....	.....	2	2	.....
	Oct. 6	954	941	.....	13	.....	1	.....	12	4	.....
		980	960	97.95	20	2.05	1	.....	19	11	.....
E	Aug. 23	7	5	.....	2	.....	.....	.....	2	2	.....
	Sept. 12	4	4	.....	.....	.....	.....	.....	.....	.....	.....
	Oct. 6	365	358	.....	7	.....	.....	.....	7	4	....
		376	367	97.60	9	2.40	.....	.....	9	6	.....
F	Aug. 23	2	2	.....	.....	.....	.....	.....	.....	.....	....
	Sept. 12	27	24	.....	3	.....	.....	1	2	2	.....
	Oct. 6	400	393	.....	7	.....	.....	.....	7	2	....
		429	419	97.67	10	2.33	.....	1	9	4	.....
	Grand total	2846	2756	96.84	90	3.16	6	1	83	33	....

Series 1, check trees

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
X	Aug. 23	68	10	.....	58	.....	30	20	8	35	13
	Sept. 12	17	.....	.....	17	.....	9	4	3	9	.....
	Oct. 6	36	4	.....	32	.....	4	15	13	19	
		19	82	.....	37	.....	20	14	3	18	5
		240	96	40	144	60	63	53	27	81	18
Y	Aug. 23	88	6	.....	82	.....	42	25	15	60	7
	Sept. 12	53	3	.....	50	.....	20	19	11	36	4
	Oct. 6	75	1	.....	74	.....	10	51	13	43	7
		255	96	.....	159	.....	51	92	16	78	4
	Grand total	471	106	22.5	365	77.5	123	187	55	217	22

Average for X-Y.....28.41.....72.59

A study of the above tables discloses several very interesting facts. In plot 1 there is not a very wide variation in the fruitage, the number of apples ranging from 114 in tree B to 627 in tree D. The percentage of sound fruit varies from 85.38 per cent in tree E, with its 171 apples, to 92.98 per cent in tree D, having a maximum yield of 627 apples. Note that tree B had only 9 wormy fruit, nearly 8 per cent of the 114 produced, while the most wormy apples were found on trees C and D, each with 44 and forming, respectively, 9.93 and 7.02 per cent of the total product. Here, at least, the percentage comparison is obviously unfair, since the two trees had, as nearly as we can determine, a practically uniform infestation, yet the percentage varies considerably, due simply to the larger crop on one tree. There were no end wormy only on tree A, while the maximum in this classification was 5 on tree C. The side wormy range from 40 in tree D to 8 in tree B. It is perhaps significant that 8.6 per cent of the total fruit in this plot was side wormy, 7.5 per cent of this being side wormy only.

Plot 2 with its second poisoned application produced approximately 6 per cent additional sound fruit. This is nearly half a barrel, or 171 apples. It is probable that the somewhat greater yield of this plot, namely 2846 as compared with the 1839 of plot 1, had its influence in the production of a somewhat larger percentage of sound fruit. It is interesting to note certain details. The minimum tree C, with only 229 apples, produced 97.81 per cent of sound fruit, while the maximum tree D, with 980 apples, yielded 97.95 per cent of sound fruit, a difference of only .06 per cent. Here again we see the obvious injustice of a strictly percentage comparison, since C yielded only 5 wormy apples while D had 20, or, in other words, supported four times as many codling moth larvae, yet, owing to the disparity in fruiting, the percentage was practically identical. The minimum percentage of sound fruit was 93.93 produced by tree A yielding 462 apples, 28 of which were wormy. The minimum number of wormy apples, five, was produced by tree C mentioned above. The number of end wormy only ranges, among the individual trees, from nothing to 4, a total of 6 for the plot, with only 1 end and side wormy. It will be seen at once that only a little over 3.3 per cent of the apples in this plot were either side or end and side wormy, or a reduction in the

number of side or end and side wormy of nearly 6.3 per cent from that of plot 1, by far the greater number being side wormy only. The gain following this second application is apparent in the almost total elimination of end wormy fruit and the material reduction in the side wormy, the actual number being nearly one-half that in plot 1.

The two check trees, X and Y, yielding respectively, 240 and 471 apples, a total of 711, 72.59 per cent being wormy, give an excellent idea of the conditions which would have prevailed had there been no application of poison. They produced respectively, only 40 per cent and 22.5 per cent of sound fruit and totals of 144 and 365 wormy apples, 80 of these on X and 242 on Y, or 33 per cent and 51 per cent respectively, of the total yield being side wormy. There were only 28.41 per cent of sound fruit on the two trees. It will be seen that under natural conditions, such as obtained last year, approximately equal numbers were end and side wormy.

Series 2. This series of three plots and two check trees was laid out in the young orchard of Mr C. R. Shons at Washingtonville. These trees are about 18 years old, 16 or 18 feet high, thrifty, rather thickly set and with a steep incline just southeast of the experimental area. The three plots and the check trees, as will be seen by reference to figure 2, were all in the same row of trees, running approximately northeasterly and consisted so far as the experimental trees were concerned, with but one exception, of Baldwins. The two check trees were farthest from the highway. The experimental trees in this series, as in the preceding, were carefully selected so as to obtain, as far as possible, uniformity in fruitage and infestation. Plots 1 and 2 were thoroughly sprayed May 11th with arsenate of lead and bordeaux mixture. The first tank of 150 gallons contained 6 pounds of arsenate of lead (15–16 per cent arsenic oxide). This was applied to the actual experimental trees and the barrier trees, spraying them together with a few trees on the northeast corner of plot 2. The second tank contained 6 pounds of arsenate of lead and was put on the remaining barrier trees on the north side of plots 1 and 2 and also on a portion of the barrier trees on the southeast corner of plot 2. The remainder of the barrier trees, namely, those on the southwest corner of plot 2 and the southern ones on plot 1, were sprayed with 2 pounds of arsenate of lead and 1 pound of paris green to 150 gallons, in con-

Fig. 2 Portion of orchard at Washingtonville showing the location of the experimental plots

nection with the bordeaux mixture. This latter consisted approximately of eight pounds of copper sulfate with enough lime to satisfy the copper, to 150 gallons.

The day was lowery with an occasional sprinkling of rain, but at no time did enough water fall to materially affect the work. The pressure was uniformly maintained at 85 to 100 pounds, a one horse gasolene engine supplying the power. Friend nozzles were employed, set at an angle and on the end of long extension nozzles, one man standing in a wagon, thus being able to throw the spray down upon even the highest blossoms. The actual experimental trees and the barriers separating them were Baldwins, while the two rows of barrier trees on the northwest were Wagners, and the same was true of the first barrier row on the southeast, the second being Baldwins. The blossoms had just dropped from the trees and the time of application was therefore nearly ideal.

Plot 2 was sprayed a second time June 1st and plot 3 for the first time on the same date. The day was cloudy with an occasional mistiness which did not interfere with the work, as there was not at any time enough moisture to wet the foliage. Six pounds of arsenate of lead (15 per cent arsenic oxide) was used to each 50 gallons of water and approximately the same formula as given above for the bordeaux mixture. 375 gallons of spray were applied to the 85 trees, it being sufficient to cause dripping in almost every instance. There was at this time no evidence of codling moth work, aside from possibly one apple which may have been entered at the side. Larvae of the green-striped apple worm, Xylina antennata Walk. and also those of a Tortricid, were rather abundant. The latter hid between the leaves and ate them as well as contiguous fruit. Apples were picked up under the experimental trees and classified August 24th, September 13th and October 4th–5th.

An examination of this orchard June 30th showed that the conditions were not so satisfactory as at Arlington. There was considerable bordeaux injury, especially on the plots receiving the early application. The poison was very evident on all the experimental trees. Those of plot 3, sprayed only on June 1st, showed less bordeaux injury than the others. The fruitage on some of the trees was disappointing, since many of the blossoms failed to set. Work of the Tortricid leaf roller, mentioned above, and the green fruit worm was quite evident.

An examination October 4th and 5th revealed much injury from the bordeaux mixture, many of the apples checking and codling moth larvae of the second brood entering at such points. An effort was made to approximate this injury and small, random samples from various trees were carefully sorted. The results are tabulated as follows:

Tree	1A	26	smooth, 48	injured
	1B	12	" 31	"
	1C	30	" 25	"
	2C	3	" 30	"
	2D	4	" 32	"
	2F	19	" 10	"
	3A	12	" 18	"
	3B	12	" 25	"
	3D	10	" 29	"
	X	77	" 23	"

We endeavored, in the above table, to put in the smooth class only those apples which were at least fairly smooth. A large proportion of those classed as injured were not seriously affected, aside from appearance, though some were badly gnarled and even cracked. It will be seen at once that a very high percentage of the fruit on all the sprayed trees were more or less rusted, while the proportions are approximately reversed on the unsprayed trees. Burning by bordeaux mixture was strikingly illustrated in Mr Shons' Ben Davis, some 90 to 95 and possibly 99 per cent of the apples being badly rusted and in some cases so seriously affected (pl. 13) that portions of the apple were irregular and more or less covered with rounded, tuberclelike elevations.

A considerable number of apples had been entered at the stem. The Tortricid larva, mentioned above, was still working on the apples in some numbers, either under a leaf, on the side of the fruit or beneath a light web at the blossom end. A note made by Mr Young September 13th records that over 90 of the 115 clean apples dropped from tree E, plot 3, had been gnawed by some larvae, probably that of this Tortricid. The work of this insect is illustrated on plates 10 and 11. A tabulation of the data obtained upon these plots follows.

Series 2, plot 1

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24	65	36	.....	29	.....	1	1	27	23	1
	Sept. 13	42	18	.....	24	.....	.....	1	23	14	.....
	Oct. 4–5	310	180	.....	130	.....	11	1	118	40	.....
	Oct. 18–19	249	168	.....	81	.....	12	2	67	17	.....
		1262	1226	.....	36	.....	4	.....	32	.....	.....
		1928	1628	84.44	300	15.56	28	5	267	94	1
B	Aug. 24	43	28	.....	15	.....	.....	1	14	11	.....
	Sept. 13	52	33	.....	19	.....	1	.....	18	12	1
	Oct. 4–5	391	182	.....	209	.....	27	5	177	81	.....
	Oct. 18–19	259	168	.....	91	.....	18	.....	73	7	.....
		911	880	.....	31	.....	8	1	22	.....	.....
		1656	1291	77.96	365	22.04	54	7	304	111	1
C	Aug. 24	77	43	.....	34	.....	1	.....	33	25	.....
	Sept. 13	83	58	.....	25	.....	3	.....	22	20	1
	Oct. 4–5	257	156	.....	101	.....	9	.....	92	38	.....
	Oct. 18–19	102	77	.....	25	.....	4	.....	21	2	.....
		578	568	.....	10	.....	1	.....	9	.....	.....
		1097	902	82.22	195	17.78	18	.....	177	85	1
D	Aug. 24	60	38	.....	22	.....	1	.....	21	16	.....
	Sept. 13	48	33	.....	15	.....	.....	.....	15	13	.....
	Oct. 4–5	185	85	.....	100	.....	9	5	86	30	.....
	Oct. 18–19	183	118	.....	65	.....	11	2	52	19	.....
		602	585	.....	17	.....	1	.....	16	2	.....
		1078	859	79.68	219	20.32	22	7	190	80	.....
E	Aug. 24	59	44	.....	15	.....	1	4	10	10	.....
	Sept. 13	35	26	.....	9	.....	2	.....	7	6	.....
	Oct. 4–5	279	158	.....	121	.....	5	.....	116	40	.....
	Oct. 18–19	217	161	.....	56	.....	8	1	47	.....	.....
		902	887	.....	15	.....	3	.....	12	1	.....
		1492	1276	85.52	216	14.48	19	5	192	57	.....
F	Aug. 24	33	16	.....	17	.....	.....	.....	17	13	.....
	Sept. 13	37	25	.....	12	.....	.....	.....	12	7	.....
	Oct. 4–5	152	84	.....	68	.....	8	2	58	36	.....
	Oct. 18–19	133	81	.....	52	.....	9	1	42	2	.....
		529	515	.....	14	.....	2	.....	12	.....	.....
		884	721	80.43	163	19.57	19	3	141	58	.....
	Grand total	8135	6677	82.08	1458	17.92	160	27	1271	485	3

Series 2, plot 2

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24	70	51	.....	19	.....	1	1	17	17	.....
	Sept. 13	49	39	.....	10	.....	.....	.....	10	6	.....
	Oct. 4–5	273	132	.....	141	.....	4	.....	137	41	.....
	Oct. 18–19	126	86	.....	40	.....	11	.....	29	9	.....
		583	572	.....	11	.....	3	.....	8	.....	.....
		1101	880	79.93	221	20.07	19	1	201	73	.....
B	Sept. 13	227	127	.....	100	.....	12	.....	88	65	.....
	Oct. 4–5	442	335	.....	107	.....	33	.....	74	31	.....
	Oct. 18–19	284	217	.....	67	.....	13	.....	54	7	.....
		1305	1284	.....	21	.....	4	.....	17	2	.....
		2258	1963	86.94	295	13.06	62	.....	233	105	.....
C	Aug. 24	38	25	.....	13	.....	2	1	10	9	.....
	Sept. 13	55	31	.....	24	.....	.....	1	23	11	.....
	Oct. 4–5	226	131	.....	95	.....	1	.....	94	25	1
	Oct. 18–19	127	85	.....	42	.....	1	1	40	6	.....
		685	675	.....	10	.....	.....	.....	10	.....	.....
		1131	947	83.73	184	16.27	4	3	177	51	1
D	Aug. 24	25	18	.....	7	.....	.....	.....	7	4	.....
	Sept. 13	69	49	.....	20	.....	2	1	17	14	1
	Oct. 4–5	192	105	.....	87	.....	3	.....	84	22	2
	Oct. 18–19	182	122	.....	60	.....	7	1	52	14	.....
		480	473	.....	7	.....	1	.....	6	1	.....
		948	767	80.90	181	19.10	13	2	166	55	3
E	Aug. 24	8	2	.....	6	.....	.....	.....	6	6	.....
	Sept. 13	7	5	.....	2	.....	1	.....	1	1	.....
	Oct. 4–5	27	17	.....	10	.....	.....	.....	10	2	1
	Oct. 18–19	30	23	.....	7	.....	1	.....	6	1	.....
		62	59	.....	3	.....	1	.....	2	1	.....
		134	106	79.09	28	20.91	3	.....	25	11	1
F	Aug. 24	96	64	.....	32	.....	2	.....	30	24	.....
	Sept. 13	103	69	.....	34	.....	4	1	29	14	.....
	Oct. 4–5	376	214	.....	162	.....	13	2	147	30	.....
	Oct. 18–19	196	136	.....	60	.....	4	1	55	16	.....
		973	959	.....	14	.....	3	.....	11	2	.....
		1744	1442	82.68	302	17.32	26	4	272	86	.....
	Grand total	7316	6105	83.45	1211	16.55	127	10	1074	581	5

Series 2, plot 3

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24	183	60	.....	123	.....	46	7	70	64	5
	Sept. 13	170	77	.....	93	.....	51	7	35	31	.....
	Oct. 4–5	537	140	.....	397	.....	162	58	177	79	2
	Oct. 18–19	219	84	.....	135	.....	71	9	55	8	.....
		371	308	.....	63	.....	33	4	26	4	.....
		1480	669	45.20	811	54.80	363	85	363	186	7
B	Aug. 24	184	79	.....	105	.....	30	9	66	70	2
	Sept. 13	113	62	.....	51	.....	23	1	27	13	.....
	Oct. 4–5	429	124	.....	305	.....	140	35	130	69	9
	Oct. 18–19	213	104	.....	109	.....	65	5	39	15	.....
		565	546	.....	19	.....	12	.....	7	.....	.....
		1504	915	60.84	589	39.16	270	50	269	167	11
C	Aug. 24	52	14	.....	38	.....	26	1	11	21	1
	Sept. 13	42	4	.....	38	.....	24	6	8	12	.....
	Oct. 4–5	115	24	.....	91	.....	50	14	27	19	.....
	Oct. 18–19	46	18	.....	28	.....	19	2	7	4	.....
		60	54	.....	6	.....	6	.....	.....	.....	.....
		315	114	36.19	201	63.81	125	23	53	56	1
D	Aug. 24	151	50	.....	101	.....	39	3	59	44	3
	Sept. 13	143	60	.....	83	.....	40	8	35	30	.....
	Oct. 4–5	456	156	.....	300	.....	111	29	160	86	4
	Oct. 18–19	185	84	.....	101	.....	56	3	42	15	.....
		773	746	.....	27	.....	17	.....	10	2	.....
		1708	1096	64.17	612	35.83	263	43	306	177	7
E	Aug. 24	229	115	.....	114	.....	65	1	48	60	2
	Sept. 13	164	39	.....	125	.....	46	37	42	44	1
	Oct. 4–5	527	127	.....	400	.....	196	35	169	94	3
	Oct. 18–19	197	66	.....	131	.....	70	22	39	32	.....
		433	401	.....	32	.....	13	11	8	5	.....
		1550	748	48.26	802	51.74	390	106	306	235	6
F	Aug. 24	87	49	.....	38	.....	16	1	21	21	1
	Sept. 13	37	27	.....	10	.....	5	.....	5	3	.....
	Oct. 4–5	138	86	.....	52	.....	8	5	39	16	.....
	Oct. 18–19	133	95	.....	38	.....	10	5	23	7	.....
		642	556	.....	86	.....	35	8	43	14	.....
		1037	813	78.39	224	21.61	74	19	131	61	1
	Grand total..	7594	4355	57.35	3239	42.65	1485	326	1428	882	33

Series 2, check trees

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
X	Aug. 24	116	10	.....	106	.....	54	18	34	47	3
	Sept. 13	77	9	.....	68	.....	43	14	11	14	2
	Oct. 4–5	136	24	.....	112	.....	62	16	34	29	.....
	Oct. 18–19	50	22	.....	28	.....	14	6	8	2	1
		117	98	.....	19	.....	17	.....	2	3	.....
		496	163	32.86	333	67.14	190	54	89	95	6
Y	Aug. 24	227	22	.....	205	.....	70	83	52	89	6
	Sept. 13	106	23	.....	83	.....	52	7	24	19	.....
	Oct. 4–5	529	68	.....	461	.....	228	97	136	96	5
	Oct. 18–19	290	65	.....	225	.....	102	71	52	53	3
		352	252	.....	100	.....	58	12	30	20	.....
		1504	430	28.59	1074	71.41	510	270	294	277	14
	Grand total	2000	593	29.65	1407	70.35	700	324	383	372	20

This series, it will be seen by reference to the above tables, presents markedly different conditions in certain respects from those of series 1. There was a considerably larger setting of fruit, the totals for the three plots being remarkably uniform, and in addition there was a very serious infestation by codling moth. This was probably due in part, at least, to local conditions and it is possible that the sprayings were not quite so thorough as those in series 1. The entire equipment was different and it is by no means easy to make exact comparisons. An earnest attempt was made to secure the most thorough work possible under the conditions. It is very likely that a portion of the discrepancy in percentages may be due to the difference in varieties in series 1 and 2. Data upon this point is given in the case of two other varieties in series 3.

A study of the data given under plot 1 shows that the minimum tree F produced 884 apples, 80.43 per cent being sound, while the maximum tree B yielded 1656 apples and but 77.96 per cent free from worms. The maximum percentage of sound fruit, namely 85.52 per cent, was produced by tree E with its total of 1492 apples while the minimum percentage of sound fruit, 77.96 per cent, contrary to the usual rule, was found on tree B mentioned above. The number of wormy fruit under individual trees ranged from 195 or 17.78 per cent on tree C to 365 or 22.04 per cent on tree B. In the case of the latter, we would call attention to the fact that practically all the wormy apples were on the ground by October 18th. The maximum number of side wormy or end and side wormy apples

311 or nearly 19 per cent of the total, were found on tree B, less than .5 per cent of these being also end wormy. The minimum number of side or end and side wormy apples was found on tree F. This was 144 or 16.3 per cent of the total yield, less than .4 per cent being also end wormy. The entire plot produced 8135 apples, of which 1298, or 15.9 per cent, were side wormy or end and side wormy, the latter being a practically negligible quantity.

Plot 2 had the minimum yield of 134 on tree E, 79.09 per cent being sound. The maximum number of apples, 2258, was produced by tree B, which yielded 86.94 per cent of sound fruit. This tree also produced the maximum number, 295, of wormy fruit, amounting however, to but 13.06 per cent of the total yield. The smallest number of wormy apples, 28, was found on tree E, and constituted 20.91 per cent of the entire product. Percentage comparisons are very strongly in favor of B, though as an actual fact it bore ten times as many wormy apples. The maximum number of side wormy or end and side wormy apples, 276, occurred on tree F, and comprised 15.8 per cent of the entire product, less than 2 per cent of the whole yield being end wormy. The minimum number of side wormy apples, 25, were found on tree E and amounted to 18.6 per cent of the total yield, less than 2 per cent being end wormy. Here again we see the injustice of strictly percentage comparisons, since F had ten times as many wormy apples as E, yet the percentage of sound fruit is strongly against the latter. This plot as a whole produced 7316 apples, 1084 or 14.8 per cent being side wormy or end and side wormy. A comparison between plots 1 and 2 shows a gain in sound fruit from the second spraying of only 1.37 per cent, though there were 247 less wormy apples on plot 2 than on plot 1.

Plot 3 presents an entirely different set of conditions, since it was sprayed but once and then in early June. The minimum tree C yielded but 315 apples, only 36.19 per cent being sound. The maximum tree D produced 1708 apples, 64.17 per cent being free from worms. The wormy apples range in number from 811 in tree A to 201 in tree C, comprising 54.80 per cent and 63.81 per cent, respectively, of the entire product. The maximum number of end wormy or end and side wormy apples was found on tree A with its 448 thus classed, forming 30.2 per cent of the entire yield. The minimum number of 76 was produced by tree C and comprised 24.1 per cent of the total. The entire plot yielded 7594 apples, 1754 or 23 per cent of the total being side wormy. The plot as a whole yielded but 57.35 per cent of sound fruit, showing a marked discrepancy between it and the two preceding plots.

The two check trees produced 2000 apples, which is not far from a fair average as these trees ran, 1407 or 70.3 per cent of the total were wormy, 707 or 35.35 per cent being side or end and side wormy and 1044 or 51.2 per cent being end or end and side wormy.

Series 3. The young orchard of Mr William Hotaling of Kinderhook, was selected for certain corroborative experiments. The trees are exceptionally fine, only about five or six years old, dwarf in habit and, as a rule, heavily laden for such young trees. They are set in four rows running approximately north, with rows of peach trees between, and, in the case of the experimental areas, the Wealthy apples are alternated with Mackintosh. The actual experimental trees were on the 30th to 35th transverse rows north from the house and located on the two middle longitudinal rows. The check trees were similarly located on the 25th and 26th transverse rows. The data relating to the two varieties has been tabulated separately. The western row of the experimental trees was sprayed with arsenate of lead (15 per cent arsenic oxide) 3 pounds being used to a 44 gallon barrel, and a lime-sulfur solution, the latter composed of 1 gallon of a homemade concentrated wash testing about 35° on a Baumé scale to about 40 gallons. The eastern row of experimental trees received the same application, except that the bordeaux mixture, composed of 4 pounds of lime and 3 pounds of blue vitriol, was substituted for the lime-sulfur wash. The spraying was done May 17th, a hand pump with a rather fine Friend nozzle being employed. Care was exercised to see that the mixture was well stirred. The application was made by Mr Hotaling personally. He took special pains to cover the under, as well as the upper, surface of the leaves, being in this respect possibly a little more thorough than in his efforts to fill the upturned calyx ends of the young fruit. Almost every leaf was well coated and only a very little dripping was observed. It is possible, owing to the slight breeze, that the northeast side of the trees was not sprayed quite so thoroughly as other portions. The intervening peach trees were not sprayed. This orchard had been well sprayed the preceding two seasons.

The fruit was picked September 16th. It is probable that a large percentage, possibly 50 per cent, of the wormy fruit was attacked at points injured by a hailstorm which occurred May 30th. These places afforded almost ideal opportunities for the entrance of young codling moth larvae. The results are tabulated on page 30.

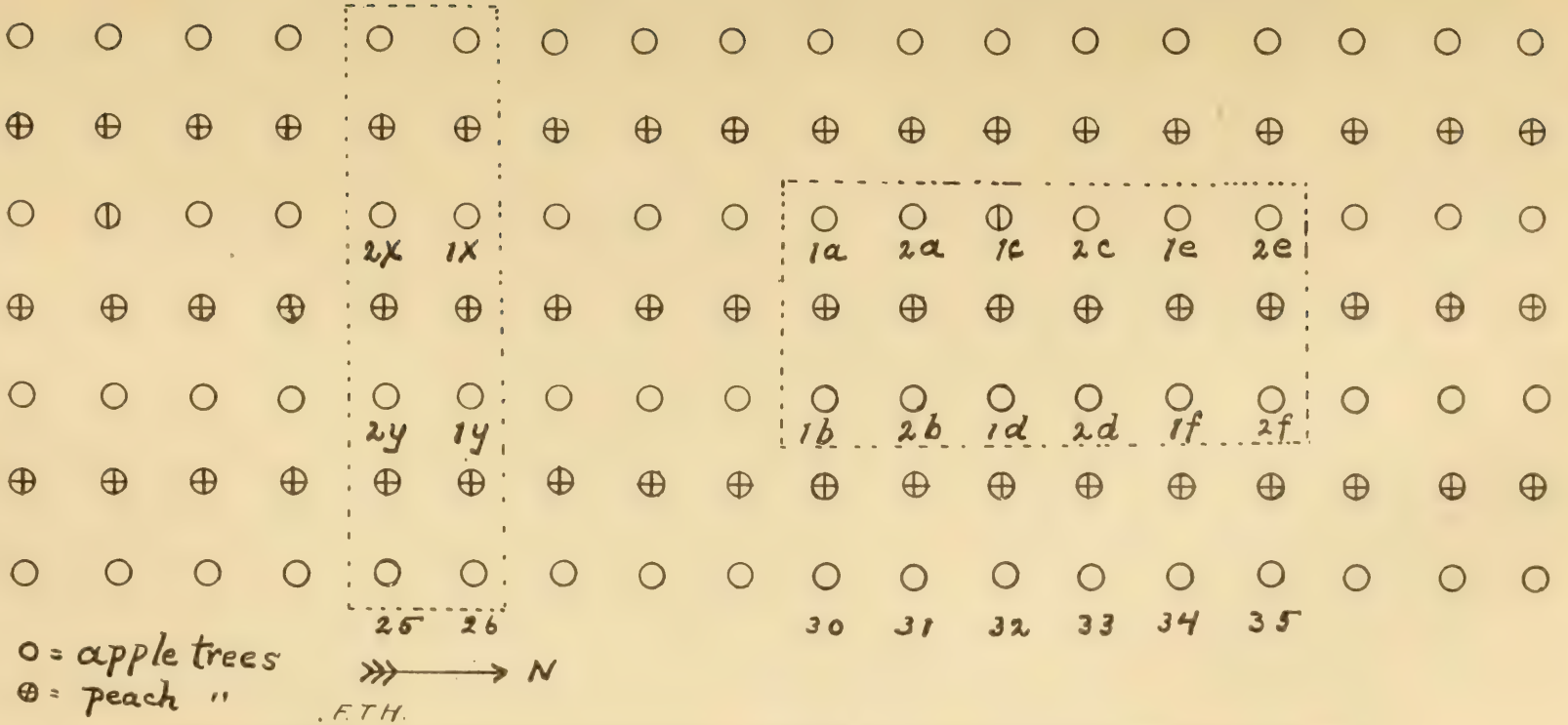

Fig. 3 Portion of orchard at Kinderhook, showing the location of the experimental trees

Series 3, Wealthy

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
1A	106	84	79.25	22	20.75	3	.....	19	3	.....
1B	28	23	82.14	5	17.86	2	.....	3	.....	.....
1C	160	114	65.22	46	34.78	2	.....	44	7	.....
1D	81	51	62.97	30	37.03	1	.....	29	5	.....
1E	121	73	60.33	48	39.67	4	.....	44	8	.....
1F	33	26	78.79	7	21.21	.....	.....	7	.....	.....
Grand total	529	371	70.14	158	29.86	12	.....	146	23	.....
CHECK TREES										
1X	38	18	47.37	20	52.63	8	6	6	.....	.....
1Y	50	18	36.	32	64.	12	7	13	2	.....
Total	88	36	43.19	52	56.81	20	13	19	2	.....

Series 3, Mackintosh

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
2A	179	110	61.46	69	38.55	8	2	59	16	.....
2B	16	8	50.	8	50.	1	.....	7	3	.....
2C	105	51	48.57	54	51.43	6	.....	48	6	.....
2D	87	27	31.04	60	68.96	9	2	49	10	.....
2E	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2F	57	23	40.36	34	59.64	1	.....	33	9	.....
Grand total	444	219	49.33	225	50.67	25	4	196	44	.....
CHECK TREES										
2X	15	5	33.34	10	66.66	6	1	3	2	1
2Y	375	125	33.34	250	66.66	78	37	135	51	3
Total	390	130	33.34	260	66.66	84	38	138	53	

This series illustrates conditions where a minimum crop is produced. The maximum Wealthy tree C yielded but 160 apples, 65.22 per cent being sound, while the minimum B bore but 28, 82.14 per cent being free from worms. The maximum percentage, 79.25, of sound fruit was produced by tree A, yielding only 106 apples, while the minimum percentage, 60.33, occurred on tree E with its crop of 121 apples and its maximum number, 48, of wormy apples. The minimum number of wormy apples was 5, occurring on tree B and constituting 17.86 per cent of the total product, 11 per cent being side wormy. This plot produced only 529 apples, 70.14 per cent being sound, 27 per cent of the total side wormy, while only 2 per cent were end wormy.

The two check trees yielded 88 apples, only 43.19 per cent being sound and with the side and end wormy nearly equal in number.

The Mackintosh trees in this series show a greater degree of infestation, though they were interspersed with the others. The

maximum tree A produced 179 apples, 61.46 per cent being sound, and also the maximum number of wormy fruit, namely 69. The minimum tree B yielded only 16 apples, 50 per cent being sound, while the minimum per cent of sound fruit, 31.04, was found on tree D with its total of 87 apples. The minimum number of wormy apples occurred on tree B, 8, or one-half the total number being thus affected. Summarizing the data for this group of trees, it will be seen that only 49.33 per cent of the total yield of 444 were sound. A total of 45 per cent of the fruit was side wormy, while only about 6 per cent was end wormy.

The check trees produced a total of 390 apples, only 33.34 per cent being sound. 45 per cent were side wormy or end and side wormy, while 31 per cent were end wormy or end and side wormy, showing in this respect a marked difference from the fruit borne by the sprayed trees.

Summary of plots

Serie	Plot	Total	Clean fruit		Wormy fruit						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
1	1.....	1839	1664	90.48	175	9.52	16	21	138	83	3
	2.....	2846	2756	96.84	90	3.16	6	1	83	33	.....
2	1.....	8135	6677	82.08	1458	17.92	160	27	1271	485	3
	2.....	7316	6105	83.45	1211	16.55	127	10	1074	581	5
	3.....	7594	4355	57.35	3239	42.65	1485	326	1428	882	33
3	Wealthy.....	529	371	70.14	158	29.86	12	.....	146	23	.....
	Mackintosh...	444	219	49.33	225	50.67	25	4	196	44	.....
1	Checks.....	711	202	28.41	509	71.59	186	240	82	298	40
2	Checks.....	2000	593	29.65	1407	70.35	700	324	383	372	20
3	Wealthy checks	88	36	43.19	50	56.81	20	13	19	2	.....
4	M'k't'h checks	390	130	33.34	260	66.66	84	38	138	53	4

A study of the above record shows almost the same percentage of infestation, namely 71.59 and 70.35 respectively, for the check trees in series 1 and 2. These two orchards were in the same general region and the results should therefore be approximately comparable. There is, however, a markedly higher percentage of side or end and side wormy in the checks of series 1, this totaling 322 and amounting to 45.28 per cent, while in series 2 the checks produced 707 side or end and side wormy, or but 35.35 per cent. The number of side wormy alone in these two checks is approximately proportional to the number of apples produced by the respective trees. These figures would indicate, in a general way at least, substantially identical conditions in the two series so far as infestation by the codling moth is concerned. A comparison of the percentage of wormy apples obtained on plots 1 and 2 in series 1 and those obtained on plots 1 and 2 in series 2, shows a marked and constant variation. Plot 1 series 1 produced 90.48 per cent of sound fruit, while the

similar plot in series 2 yielded only 82.08 per cent. Likewise, plot 2 in series 1 bore 96.84 per cent of sound fruit, number 2 of series 2 yielding only 83.45 per cent of worm-free fruit. It will be seen that there was a variation of from a little over 8 to over 13 per cent in favor of the plots in series 1. This may be explainable in part by the fact that the orchard in series 1 was younger and somewhat cleaner than in series 2, though it would seem as if some of this discrepancy must be attributed to less efficient spraying in series 2, especially as the experience of last year showed that an apparently minor factor, namely, a slightly less thorough spraying on one portion of a tree, resulted in reducing the amount of sound fruit by 2 to 3 per cent, and it is possible that a slight difference in the thoroughness of application, accentuated perhaps by the lack of an automatic mechanical agitator, was responsible for most of this discrepancy. There may also have been in the case of series 2 less thorough work on the trees adjacent to the experimental area than was the case in series 1. This was especially likely to occur on the trees lying on a steep hillside to the southeast of the experimental trees, where spraying could hardly be so thorough as in the comparatively level orchard where the experiments in series 1 were conducted. Allowance should also be made for the difference in varieties. Furthermore, the trees in this orchard were rather close together and this would be a great hindrance to the best work. It is interesting to compare the side or end and side wormy between these various plots. Plot 1, series 1, produced only 159, constituting some 8.64 per cent for the entire yield, while plot 1, series 2, yielded 1298 such fruit or 15.9 per cent of its entire product. Similarly, plot 2 of series 1 bore 84 side or end and side wormy, only 3.3 per cent of the entire yield, while plot 2, series 2, produced the relatively much larger number of 1084 or 14.8 per cent of the total number. Stated in another way, if we take the check trees as a standard, one application in plot 1 reduced the percentage of side or end and side wormy by 36.64 per cent, while a similar application to plot 1 in series 2 reduced this percentage only 19.45 per cent. Likewise, two applications in series 1 made a difference of 41.98 per cent of side or end and side wormy, while in plot 2 there was a difference in this respect of only 20.55 per cent. These figures all go to show that for some reason there was a decidedly lower efficiency in series 2 than in series 1.

Plot 3 of series 2 illustrates a totally different condition, since the one spraying was not given till about June 1st. We find a much lower percentage of sound fruit, namely 57.35, while the tree yielded

1754 side or end and side wormy apples, or 23 per cent of its entire product, or this one application, taking the check trees again as a standard, reduced the percentage of side or end and side wormy by only about 12 per cent. These figures give an excellent idea of the relative inefficiency of one application made at this season of the year.

A comparison of the totals in series 3 reveals an entirely different condition of affairs. The percentage of sound fruit was only 70.14 on the Wealthy and but 49.33 on the Mackintosh, the former variety yielding 146 side or end and side wormy, or 27 per cent of the entire product, while the latter produced 200 such apples or 45 per cent of the total yield. The checks in the Wealthy and Mackintosh respectively had 43.19 and 33.34 per cent of sound fruit, the former variety producing 32 side or end and side wormy, or 36.36 per cent, while the latter variety yielded 176 such apples, or 45 per cent. Again, taking the checks as a standard, it will be seen that, in the case of the Wealthy, one spraying reduced the wormy apples by 26.95 per cent, while on the Mackintosh the same treatment gave a reduction of only 15.99 per cent. The spraying of the Wealthy trees reduced the percentage of side and end and side wormy by about 9 per cent, while there was apparently no benefit in this respect on the Mackintosh. Percentage comparisons are certainly not very favorable when applied to small trees producing only 16 to a maximum of 375 apples, though they yield from only 5 to 69 wormy apples, a number smaller than that found on any trees in the other series where the percentages of sound fruit are much greater.

Tabulation of side wormy apples

SERIES	PLOT	NUMBER	%
1	1	159	8.64
	2	84	3.3
2	1	1 298	15.9
	2	1 084	14.8
	3	1 754	23.
3	Wealthy	146	27.
	Mackintosh	200	45.
	1 Check	322	45.28
	2 "	707	35.35
	3 "	.....	.....
	Wealthy check	32	36.36
	Mackintosh check	176	45.

Comparison of data with work of previous year. A comparison of the summarized figures given above with those obtained in 1909 shows that the codling moth was very much more abundant and

injurious last season. This is true of the check trees as well as c those which were sprayed. The check trees of last year produce as much sound fruit as some of the sprayed trees in 1910, thoug this is true only where very exceptional conditions prevailed. Th percentage of wormy fruit was very much less than the prese year, while the percentage of side and end and side wormy wa even smaller, ranging in plots 1 to 6 in 1909 from less than 1 to 1 per cent. A similar condition obtained on the check trees, whic produced 17.62 per cent of side or end and side wormy.

Conclusions. The data secured shows that it is possibl with but one spraying to obtain over 90 per cent of sound fruit in year when the codling moth is very abundant, even on trees yiel ing only 300 to 500 apples. A larger crop, as pointed out on pr ceding pages and in our discussion of the effects of maximum an minimum crops on the percentage of wormy fruit in 1909, woul undoubtedly result in the production of a still greater proportio of sound fruit.

Second, we believe that the possibilities of one thorough time spraying have habitually been underrated. The second applicatio within a week or ten days after the blossoms drop, is practical a confession that the first spraying was not thorough. It is tru that ideal conditions are rarely present and it not infrequentl happens that spraying must be done even when working at a di advantage. There are, therefore, times when a second sprayin justifies itself, particularly if this is made about three weeks aft the blossoms fall and at a time when the young apple worms a beginning to feed upon the foliage and search for a favorable poi of entry upon the fruit.

Third, a later application would pay for itself under such co ditions as obtained the past season, though the percentage of sou fruit might not be greatly augmented. Here we have an excelle opportunity for exercise of judgment. A large crop with indic tions showing only a moderate abundance of the codling mot should mean that in the great majority of cases one spraying wou afford adequate protection. On the other hand, a small crop, e pecially if likely to be accompanied by high prices, would at lea justify a second application.

Fourth, adverse conditions, such as crowded trees, steep slope inferior spraying outfits, etc., make thorough work difficult, an have an appreciable influence in increasing the percentage of worm fruit, since thoroughness as well as timeliness is an importa factor in controlling the pest.

Fifth, an adhesive poison, such as arsenate of lead, appears to be much more satisfactory, since it is not only fully as effective in checking the codling moth but appears to be extremely valuable in controlling such leaf feeders as the Tortricid observed upon the orchards in series 2. This insect and associated feeders are undoubtedly of importance in increasing the amount of wormy fruit.

Sixth, there are those who hold the single spray method to be of comparatively slight importance, even if nearly as efficient, because in many localities it is necessary, or has been considered necessary, to spray several times for the control of fungous diseases. Conditions in the Hudson valley are such as to hardly justify the repeated applications so generally in vogue in the western part of the State. Here, at least, we believe that a knowledge of the possibilities of one treatment will prove an important factor in encouraging thorough spraying and result in the more general production of sound fruit.

JUNIPER WEBWORM

Dichomeris marginellus Fabr.

Twigs of Irish juniper infested by a reddish brown, white-striped larva about one-quarter of an inch long were received February 28, 1910, from Mr S. G. Harris, Tarrytown. These active larvae webbed the needles together and it was found later that they throve almost as well upon the partially dried foliage as though it were in a succulent condition. A larger amount of material was kindly sent by Mr Harris in March and the species was also received through the State Department of Agriculture from Mr L. D. Rhind, Plandome, L. I. A fine series of moths was reared in late May and early June. These were provisionally identified as the above named species, the determination being confirmed by Mr August Busck of the United States National Museum.

This European species does not appear to have been previously discovered in America. Its distribution, as given by Dr H. Rebel, is Europe, except the polar regions and Siberia. A number of English localities are indicated by Meyrick in his British Lepidoptera. This beautiful imported species, easily recognized by its yellowish brown, broadly white-margined fore wings, will hardly become a serious pest, since its food plant is of very little commercial importance.

Life history. The active larvae are gregarious, spin a rather copious web and apparently thrive upon the dead or dying foliage almost as well, if not better, than upon the more healthy tissues. The transformation to the pupa occurs within the webbed mass,

the beautiful moths appearing as stated above, the latter part of May or early in June. It is possible that there is more than one generation annually.

Description. *Adult.* Length 7mm., wing spread 15mm. Tongue brownish yellow, slender, length 4mm. Palpi porrect, compressed, about 2.5 mm. long, thickly scaled, the outer and apical portions dark brown, the dorsal part creamy white; near the middle there is a slender, light brown pencil, fuscous apically, nearly as long as the palp and extending dorsally. Antennae long, slender, finely serrate, sparsely scaled. Eyes black. The vertex crowned with a spreading mass of long, creamy white scales. Thorax creamy yellow, margined laterally and anteriorly with fulvous brown scales. Fore wings long, narrow, fulvous brown, anteriorly and posteriorly broadly white-margined, these markings disappearing just before the apex of the wing; the fringe on the apical portion of the fore wing a mottled grayish and dark brown; hind wings satiny white, the fringe long, delicate, the under surface of both wings a nearly uniform pearl-gray. Abdomen yellowish brown, the fifth, sixth and seventh segments slightly darker and apically with a tuft of long, brownish yellow scales. Legs mostly reddish bronze.

Pupa. Length 5.5 mm., rather slender, reddish brown, the wing and antennal cases dark brown and extending to the fourth and fifth abdominal segments, respectively, the latter reddish brown, margined posteriorly with light reddish brown, sparsely setose; terminal segment subacute, narrowly rounded, with a cluster of five or six irregular, long, slender, hooked spines.

Larva. Length 6 mm. Head dark reddish brown with sparse setae. Antennae yellowish brown, short; thoracic shield broad, a variable dark brown, setose. Body light brown, the segments distinct and longitudinally striped as follows: median stripe reddish brown, submedian stripes whitish, sublateral dark brown, the lateral stripes light reddish brown, all somewhat broken. Setae with a length about half the diameter of the body, light brown; tubercles small, brown; thoracic legs dark brown, prolegs yellowish white, apically light brown; anal plate reddish brown, the middle paler, posterior margin dark brown, sparsely setose.

Bibliography. The following are a few of the more accessible publications relating to this species. For additional citations the reader is referred to Rebel (1901).

1781 **Fabricius, J. C.** Spec. Insect. 2:307 (Alucita marginella).
1895 **Meyrick, Edward.** Hndb. Brit. Lepid. p. 607, 608 (Ypsolophus).
1901 **Rebel, H.** Cat. Lepid. Palaearc. Faun. 2:159 (Nothris).
1901 **Felt, E. P.** Econ. Ent. Journ. 3:341.

LARGE APHID SPRUCE GALL

Chermes cooleyi Gill.

Several specimens of this large gall on Colorado blue spruce were received July 22, 1910 through agents of the State Department of

Agriculture. At this time the galls were just opening and hosts of plant lice were issuing from their orifices. The aphids present a general resemblance to those of the more common spruce gall aphid, Chermes abietis Linn., though the galls themselves are easily distinguished by their greater size and especially their elongate character.

This new gall insect is a native of the Rocky mountain region and the Northwest, having been described in 1907 by Prof. C. P. Gillette, who states that he has observed this gall mostly upon blue spruce in Colorado from 4000 to 8000 feet altitude and chiefly upon Englemann's spruce above the 8000 foot line. He adds that he has seen specimens from the Northwest through the courtesy of both Drs Fletcher and Hopkins, and in each instance they were the typical galls of this new form. He finds this gall most numerous in parks or lawns where the blue spruce and the red fir are clustered together.

Description. The galls (pl. 17, fig. 1) are long, slender, terminal enlargements having a length of two inches or more and a diameter of approximately half an inch. According to Professor Gillette, they are always terminal and kill the end of the twig, except when the lice attack the bases of only a few needles on one side of the new growth, such being uncommon. Professor Gillette states that average galls have from 75 to 150 chambers, the lice from five large sized galls ranging in number from 463 to 996.

Aphids. The plant lice within the galls are light red in color with the bodies more or less covered with a white, waxy secretion which occurs both as a powder and as threads. (Gillette)

Stem mother. In winter or early spring grayish, about .6 mm. long by .3 mm. wide. Body almost black with a white secretion radiating as short, stout threads about the margins of the body and rising in a crest down the median line of the back. (Abstract from Gillette)

Adult viviparous female. Length 1 to 1.5 mm., width .8 to 1.2 mm., dark rusty brown, the dorsal surface mottled with dark spots, the wax glands which occur upon all segments but the last. Glands arranged as follows: A nearly continuous line on the anterior margin of the head and two patches on a side near the posterior margin, the thorax and abdominal segments with three glands on a side, but segments five to eight of the abdomen have the patches more or less united, especially in the dorsal rows, the other glands on the dorsum with pores quite uniform in size and rather small. Ventrally there is a pair of small patches upon the head behind the bases of the antennae and another pair of about the same size just in front of the middle coxae. Antennae very small, about as long as the femora of the fore legs; first and second segments short and stout, about equal; third nearly cylindric, nearly twice as long as segments one and two combined and with two tactile hairs apically.

Legs short, rather weak; tarsi biarticulate, the basal segment very short. (Abstract from Gillette)

Eggs. Length .3 mm., width .17 mm. They are light amber yellow at first, covered with a white powder. They are each attached by a thread, the whole mass adherent, an average sized one with a diameter of 2 mm. (Abstract from Gillette)

Winged female. Bright shining, rufous at first but by the time the wings are expanded the eyes are black and a few hours later the head and mesothorax are black. The other portions gradually darken, the abdomen retaining the rusty color longest. The white secretion begins to show about an hour after the pupal skin is cast and the aphid soon flies away. Length 1.5 to 2 mm. Wings a little smoky with a large stigma that is slightly green and a yellow costal nerve. The median fore wing is about 2.5 mm. long or about 1.6 times the length of the body with two simple discoidal veins and one stigmatal; hind wing with one discoidal vein, length of the hind wing about equaling the length of the body. Antennae dusky, with five segments, about ¾ as long as the greatest transverse diameter of the head; segments one and two short, stout, cylindric, about equal in length, segment one smooth, the others with impressed, transverse lines or wrinkles; segments three to five subequal, with segment three a little stouter and more conical; segments four and five rather slender, not especially enlarged apically nor swollen for the transverse sensoria, of which there is one to each of the three terminal segments, the fifth with two short hairs apically. (Abstract from Gillette)

Life history. The small, hibernating form of this aphid winters upon the twigs of its host plant with its long setae thrust into crevices in the bark between the needles. The heavy winter skin is cast about the middle of April and in a day or two the white, waxy secretion indicates the location of the louse, which is invariably on the under side of the twig. The first eggs are deposited in Colorado the latter part of April and before the female has attained her maximum size. The white, waxy threads completely hide both the egg and the female; a mass contains 500 eggs. The earlier deposited eggs begin to hatch before the females have completed laying, a large number of young being observed the latter part of the month. The formation of the gall is evidently produced by the young plant lice locating at the base of the young needles. The galls develop with surprising rapidity and are due to the thickening and lateral enlargement of the bases of the needles together with a swelling of the stem. They become fully developed about the first of July and by the middle or the latter part of that month most of the lice escape, a condition paralleled by our observations in New York. This generation in Colorado flies to the red fir, establishes itself upon the leaves and begins

almost immediately to lay eggs which accumulate in large piles beneath the wings. Individuals of this generation may produce about 150 eggs. Occasionally a few specimens feed and oviposit upon the blue or silver spruce, though this is unusual. The aphids hatching from these eggs remain upon the red spruce throughout the winter and are probably the chief, though perhaps not the only, source of the variety coweni Gill. It is also considered probable that the stem mothers for the two summer broods of C. cooleyi Gill. come in a similar manner from the winged females of variety coweni Gill. of the red fir. (Abstract with additions from Gillette)

Remedial measures. It is probable that, as in the case of the spruce gall aphid, Chermes abietis Linn., thorough spraying of the infested trees in April with a whale oil soap solution, 1 pound to 2 gallons of water, would prove very effectual in checking this insect. The galls may also be cut off and burned in June, thus destroying the aphids before they have an opportunity to escape.

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ASH PSYLLA

Psyllopsis fraxinicola Först.

A number of small, yellowish or green, black-marked Psyllids, accompanied by badly curled ash leaves (pl. 15), were received from Rochester June 18, 1909. The insects were evidently very abundant and causing serious injury. The affected foliage was not only badly curled, but streaked here and there with purplish veins. The only other record of this European species in America appears to be that by Dr John B. Smith in his list of insects issued in 1899. He states that this Psyllid was imported from Europe and is quite injurious to ash trees. Dr L. O. Howard, through whose courtesy this species was determined, states that this form was found many years ago on the grounds of the Department of Agriculture, Washington, D. C. This species is reported as occurring all over Europe and, contrary to what we find in this country, the foliage is not deformed. It is about the same size as the widely distributed and much better known pear Psylla, Psylla pyricola Först, though easily distinguished therefrom by the white, tufted young, the lighter color and its occurrence upon ash.

Description. Length about 1/20 of an inch, yellowish or greenish and with yellowish or dark brown markings as follows: Submedian triangles on the pronotum; submedian and sublateral longitudinal stripes on the mesonotum and most of the metanotum. Antennae long, slender, yellowish or greenish, the first segment short, obconic, the second stout, cylindric, the third slender, fully three times the length of the second, the fourth less than ½ the length of the third and rather closely united with the somewhat longer fifth, the sixth, seventh, eighth and ninth, each subequal and about as long as the fifth, the tenth about ⅔ the length of the ninth, the eleventh reduced, ½ the length of the tenth and apically with stout spines, the ninth and tenth distally and the eleventh somewhat enlarged; eyes reddish. Fore wings mostly hyaline, variably fuscous along the anterior margin, near the distal third, in the region of the distal fourth and apically (pl. 16, fig. 1). The legs are a variable yellowish or green, the tarsi (pl. 16, fig. 6) being somewhat darker. The abdomen is yellowish or greenish with variable fuscous markings. The male of this species is remarkable because of the greatly developed genitalia projecting dorsally. The anterior organ is subtriangular and with a length about equal to half the width of the wing, while the posterior organ is irregularly subquadrate, stemmed and fuscous. A view of the extremity of the male abdomen is given on plate 16, figure 3. The female has somewhat the same general appearance as the opposite sex, being easily distinguished therefrom by the abdomen tapering to a subacute apex, bearing the ovipositor and secondary sexual organs (pl. 16, fig. 4).

The nymphs or young have the dorsum of the head mostly fuscous, the wing pads brown, the anterior abdominal segments greenish, the posterior fuscous and ornamented with a waxy secretion, the latter being produced at the lateral and posterior angles as long, waxy threads. The antennae are yellowish green, the basal and distal segments fuscous. The legs are yellowish green, the tarsi fuscous.

Life history. This species appears to have about the same life cycle as the pear Psylla, the adults wintering on the bark of the tree and the insects becoming abundant in June.

Control measures. It is probable that this pest could be controlled where circumstances warranted, by scraping the bark and spraying thoroughly in early spring with a contact insecticide, such as a lime-sulfur wash, a kerosene or petroleum emulsion, a strong whale oil soap solution or a tobacco extract for the purpose of destroying the hibernating Psyllids.

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NOTES FOR THE YEAR

The following are brief notices of some of the more injurious or interesting species which have been brought to our attention during the past year.

FRUIT INSECTS

Pear slug (*Eriocampoides limacina* Retz.). This insect very frequently occurs upon cherry and pear foliage in midsummer. The slug, only about one-half an inch long when full-grown is easily recognized by the slimy secretion covering an apparently olive colored or blackish, sluglike body, the anterior portion being distinctly enlarged. The work of this pest is very characteristic, since it skeletonizes the upper surface of the leaves more or less completely, the injured portion soon drying and turning brown. This species was unusually numerous the past summer in the vicinity of Kinderhook, N. Y., and extraordinarily abundant in the outskirts of Albion. The insect winters in the ground, the small, black, 4-winged, many veined sawflies, only about one-fifth of an inch long appearing in early spring and depositing their eggs singly in a slit through the upper surface of the leaf. The eggs hatch in about two weeks, the voracious slugs completing their growth in about twenty-five days. There are two generations, the larvae of the second usually being the more abundant and frequently occurring in numbers during July and early August.

It is comparatively easy to control this pest when necessary by spraying with a poison, since the somewhat sensitive slugs feed upon the upper surface and are therefore easily destroyed. One pound of arsenate of lead (15 per cent arsenic oxide) to 100 gallons of water would probably be sufficient, since paris green has been recommended at the rate of 1 pound to 250 gallons of water. The poison may also be applied dry or the slimy slugs destroyed by liberal, and if necessary, repeated applications of dry materials, such as air-slaked lime, land plaster, or even road dust.

Cigar case bearer (*Coleophora fletcherella* Fern.) Very few specimens of this destructive leaf miner were observed in apple orchards in the towns of Byron and Stafford, Genesee county, though it was quite abundant in some sections the preceding year and has been responsible, in part at least, for the practical destruction of several orchards. A serious infestation by this pest is likely to mean the loss of a crop, since the voracious

caterpillars, after wintering in their characteristic cigar-shaped cases attached at right angles to the twigs and nearly a quarter of an inch long, are very hungry and devour the young leaves and developing blossom buds with equal avidity. Very thorough early applications of a poison, using preferably arsenate of lead (15 per cent arsenic oxide) is advisable wherever this pest is numerous, though we have yet to find an orchard which has been well sprayed for several years, badly infested by this pest.

Cherry fruit fly (Rhagoletis cingulata Loew). This relatively new pest of the cherry grower has been somewhat abundant and injurious to Morello cherries in particular, at Germantown and vicinity. Mr S. E. Miller states that in 1909 the cherry crops of some five or six growers in that section were rather seriously affected by this maggot, though an investigation of local conditions in 1910 leads us to believe that in some instances at least, the injury may have been due in part to the plum curculio, Conotrachelus nenuphar Herbst. An examination of conditions June 29, 1910 in the orchard of Mr Miller showed that a few adult flies could be found upon each tree. There were no signs of oviposition, though the insects were frequently observed upon the fruit. We found a number of cherries infested by the curculio, though there was no evidence of the presence of maggots. Mr Miller was not certain but that the major portion of the serious injury of last year was due to curculio attack rather than to the work of the fruit fly. This year he sprayed with a poisoned lime-sulfur wash earlier in the season and the application was doubtless of service in controlling the plum curculio. Mr Miller, at our suggestion, had sprayed the trees with sweetened arsenate of lead (3 pounds of sugar and 4 ounces of arsenate of lead to 5 gallons of water) the previous week, probably the 23d. The mixture was dry and very evident upon the margins of the leaves, though none of the flies were observed working thereupon. There was no evidence of dead insects.

The orchard was visited on the afternoon of July 5th by Assistant State Entomologist Young. The day was sunny and very hot and comparatively few flies were then seen. The next morning flies were more in evidence, especially in certain portions of the orchard. They were taken in copula and a number of individuals captured. The insects became more active as the day advanced though oviposition was not observed. Some of the poisoned bait prepared by Mr Miller and described above, was sprinkled on a branch at 9.55 a. m. at what seemed a favorable place for the flies, and, although

there were numbers about the tree, it was five minutes before one alighted upon the sprinkled leaves. It appeared to feed and then walked about on the leaves and finally came to rest. It was observed for some thirty minutes moving about normally and then suddenly disappeared. A serious defect in the mixture is the rapidity with which it dries. It was found that individual flies could be captured by bringing the fingers near to the insect and then as it lit thereupon suddenly closing them. Subsequently it was found that the flies were attracted to the fingers probably because they were stained with cherry juice. This suggests that the poisoned bait mentioned above might be made more effective by the addition of some such flavor.

The evidence obtained the past season, while far from being as satisfactory as one would wish, is certainly not very promising so far as this poisoned bait is concerned. It is probable that our cherry growers will find a large measure of relief, if not practical immunity from injury, by picking cherries as soon as they are ripe and taking special pains to secure all the fruit, thus reducing the opportunities for the breeding of the flies and consequently lessening the danger of trouble the following season. We are inclined to believe that so far as this insect is concerned, prompt and thorough harvesting will afford a practical solution of the difficulty. Injury by plum curculio, an associate of the cherry fruit fly, can be controlled by persistent use of the beetle catcher or the employment of a poisoned mixture such as that used by Mr Miller the past season.

Lined red bug (Lygidea mendax Reut.).[1] Several years ago the late Professor Slingerland noticed briefly, as an apple insect, a small, red Hemipteron under the popular name of red bug (Heterocordylus malinus Reut). The form under discussion is very similar in appearance to the earlier described species, though easily separated therefrom by the much more prominent eyes and especially, as pointed out by our wellknown authority in this group, Mr E. P. Van Duzee, by the black line along the posterior margin of the pronotum.

The work of this new apple pest may be observed during May and early June on the three or four terminal, more tender leaves. These are more or less curled and frequently form partially inclosed retreats containing a brilliant red, partly grown bug. It is probable that this species injures the fruit as well as the red bug. The affected leaves have much the appearance of being injured by plant

[1] 1909 Acta Soc. Scient. Fenn., v. 26, no. 2, p. 47.

lice or aphids, though the ill-defined, brown spots suggest the possibility of their having been affected by sun scald or some obscure disease. The spotting of the tender leaves is somewhat the same as that on currant foliage, produced by the 4-lined leaf bug (Poecilocapsus lineatus Fabr.). Many tips were thus affected on the apple trees of Mr S. E. Miller of Germantown and the insect was somewhat abundant in the orchard of Mr C. R. Shons of Washingtonville, the nymph, presumably of this species, being taken in the last named orchard June 1st and three adults June 30th. The latter were secured only after repeated collecting, since the insects were by no means abundant. It is possible that some of the work described above is due to the operations of the red bug (Heterocordylus malinus Reut.) a species having similar habits.

These two forms resemble each other very closely and we take this opportunity to put on record their salient characteristics.

Lygidea mendax Reut. *Adult.* Length 6 mm., rather slender, the width 2 mm. The color varies from yellowish red to rather bright red and may be variably suffused with fuscous, this invariably forming a median stripe extending from the scutellum to the tip of the wing and including the membrane. Head dark red or yellowish red, the clypeus fuscous; rostrum extending to the posterior coxae, a variable fuscous yellowish, fuscous basally and apically. Eyes large, very protuberant, coarsely granulate. Antennae fuscous, hairy, first segment stout, with a length only half that of the greatly produced, slender second segment, the third segment slender, about half the length of the second, the fourth a little shorter than the third. Pronotum coarsely punctured, sparsely setose and margined posteriorly with a broad, black line, sometimes slightly broken mesially. Scutellum reddish or yellowish red, the posterior half, especially the submedian areas, a variable fuscous; the clavus, the internal angles of the wing, and the membrane mostly fuscous, forming a variable broad median stripe. Abdomen a variable red. Coxae red, trochanter and femora pale yellowish; tibiae fuscous yellowish or fuscous, the biarticulate tarsi a variable fuscous.

Partly grown nymph. Length 3 mm., width 2 mm., bright red, the tips of the wing pads a variable fuscous. Antennae yellowish fuscous. Legs mostly fuscous yellowish, the tibiae and tarsi slightly darker.

Heterocordylus malinus Reut. Length 6 mm., rather slender, width 2 mm., yellowish red or dark red with conspicuous fuscous markings and sparsely clothed with fine, whitish or yellowish white scales. Head triangular, mostly fuscous, the front sparsely clothed with small, whitish scales; rostrum a variable reddish brown and extending nearly to the posterior coxae. Antennae dark reddish brown, the first segment stout, length about ⅓ that of the greatly produced, more slender second segment, the slender third segment

about ½ the length of the second, the fourth shorter than the third, the apical ⅔ slightly dilated. Eyes rather prominent, coarsely granulate and reddish brown. Pronotum reddish brown, the anterior third fuscous, except the lateral angles, all sparsely clothed with small, white scales. Scutellum, the most of clavus and the membrane fuscous; the corium mostly red with a variable fuscous area in the middle and sparsely clothed with fine scales. Abdomen reddish brown; coxae, femora and tibiae mostly reddish brown, the tarsi somewhat fuscous.

This species is easily distinguished from the preceding by the fuscous area anteriorly on the pronotum, the absence of a fuscous margin posteriorly and by the fine, whitish scales on the head, thorax and wings.

Professor Crosby of the Cornell Agricultural Experiment Station finds a tobacco whale oil soap solution applied just before blossoming to be an effective spray for use against the young red bugs.

Pear psylla (Psylla pyricola Först.). It will be recalled that the season of 1903 was remarkable for the excessive abundance of this jumping plant louse. It was so numerous then that pear trees with blackened, scanty foliage or almost none at all, were common sights during the summer, not only in the Hudson valley but also in central and western New York. Since then there has been comparatively little injury, at least of a general nature. Last season this pest was rather abundant in the pear orchard of James Clark at Milton. On July 21st there were numerous nymphs and some adults upon the trees and considerable honeydew, though this latter had disappeared largely following the rain of a few days earlier. There were very little or no Psylla to be seen upon the pear trees of Mr J. A. Hepworth near the river or upon those belonging to other growers in the immediate vicinity. Reports were received of serious injury by this pest in the central part of the State.

The experience of the past few years has shown that thorough spraying in early spring with a lime-sulfur wash, such as is used for the control of San José scale, is at least a powerful deterrent, if not a preventive of Psylla outbreaks. Mr J. R. Cornell of Newburgh believes that the efficacy of such treatment is materially increased by previously scraping the rough bark from the trees. This is undoubtedly true, and where orchards are liable to injury by this species we would advise careful scraping prior to the application of a lime-sulfur wash or a miscible oil. This should be followed in every instance by closely watching the trees during the summer. Should Psylla begin to be abundant it should be checked at once by thorough spraying with a kerosene or petroleum emul-

sion, a whale oil soap solution, or a tobacco preparation, making the application, if possible, just after a rain and using a coarse, forcible spray. The advantage of spraying just after a rain is that the moisture washes away in large measure the sticky excretion which protects the young Psyllas and thus renders them more susceptible to the application. A coarse spray is more effective than a fine, drifting fog because of its tendency to remove this protecting secretion.

San José scale (Aspidiotus perniciosus Comst.). The experience of the past year has but served to confirm the value of early and thorough applications of a lime-sulfur wash for the control of this pest. It is comparatively easy at the present time to find orchards which have been infested by San José scale for ten or fifteen years and yet show very few signs of its presence. This is due, in our opinion, to two factors. First, our methods of spraying have been gradually perfected so that the work of later years has been exceedingly thorough. Second, there has been a marked development in the preparation of the lime-sulfur washes, particularly in the commercial brands. There is no doubt as to the value of a well prepared homemade lime-sulfur wash, whether an excess of lime or a larger proportion of sulfur be employed. The formulas generally used till within the last year or two, usually called for a little more lime than sulfur. This preparation has demonstrated its effectiveness time and again and must still be regarded as an exceedingly valuable insecticide. Nevertheless, the so called concentrated lime-sulfur washes, distinguished from the earlier formulas by the use of approximately twice as much sulfur as lime by weight, have given exceedingly satisfactory results and possess several important advantages. This latter type of wash can be made up months in advance without danger of crystallization, provided freezing does not occur, and in a well made wash of this character there is practically no sediment. These two considerations are of great importance to the fruit grower who is frequently pushed for time in early spring, when the spraying can be done to best advantage, and is therefore unwilling or unable to take time to prepare the wash while spraying operations are being conducted. It is perhaps needless to add that this lack of sediment greatly reduces the danger of clogging nozzles and consequent delay in operations. Experiments have shown that the clear concentrated lime-sulfur wash is as effective, or at least nearly so, in destroying the scale as the old type of wash with its large excess of lime and frequently considerable sediment. The one trouble with the use

of the clear mixture is the difficulty of doing thorough work, because when recently applied it can not be seen readily. This trouble can be obviated to a large extent by adding a little milk of lime to the diluted mixture, using it simply as a marker.

Certain reports have come to this office to the effect that the San José scale was becoming less abundant or even dying out in restricted localities here and there in the State. There are undoubtedly trees, and possibly orchards, where the scale has not thrived to any great extent in recent years, but we have yet to find substantial evidence showing this to be at all general. The scale appears to be most abundant upon vigorous trees, and while we would not state it as a general rule, we believe that in most instances freedom from infestation is correlated in large measure with reduced vitality and a consequently limited fruition.

Blister mite (Eriophyes pyri Nal.). This small pest, as shown by personal examination, is generally present in the orchards of Byron and Stafford, Genesee county, frequently being very abundant in those which have not been sprayed. This mite is widely distributed in the Hudson valley, though very rarely numerous enough to cause material injury. It was observed by the writer somewhat generally distributed in orchards at Clarksville, Albany county, and also very prevalent in the orchard of Mr Cecil Boudewyns at La Grangeville. There is no question as to the efficacy of early spring applications of a lime-sulfur wash or a miscible oil for the control of this pest. The general characteristics of its work and control methods have been discussed by the writer in Museum Bulletin 134, page 48.

GARDEN AND GRAIN INSECTS

Rose scale (Aulacaspis rosae Bouché). This insect is widely distributed in both Europe and America, occurring mostly upon rose, blackberry and raspberry bushes, particularly in sheltered locations. It is easily recognized by the thin, papery white, oval scale of the female only about one-sixteenth of an inch in diameter and with a small, yellowish patch, the protection of the immature stage, near its apex. The white male scale is easily recognized by its smaller size, the narrow three ridges and the small, yellowish particle at one extremity. The appearance of a blackberry cane rather badly infested by this insect is well shown in figure 4, while the female and male scale are represented much more enlarged in figure 5.

This rose pest is widely distributed in America, having been recorded from Florida and Louisiana northward to New York, and even from California. It is said to hibernate in an immature condition in the extreme south. Professor Comstock records the issuing of males, oviposition by females and hatching of eggs February 22d from material taken in Florida, while Professor Morgan states that young appear in Louisiana the last of March.

Fig. 4 Portion of blackberry cane enlarged and showing a rather bad infestation by the rose scale. Numerous female and male scales are represented.

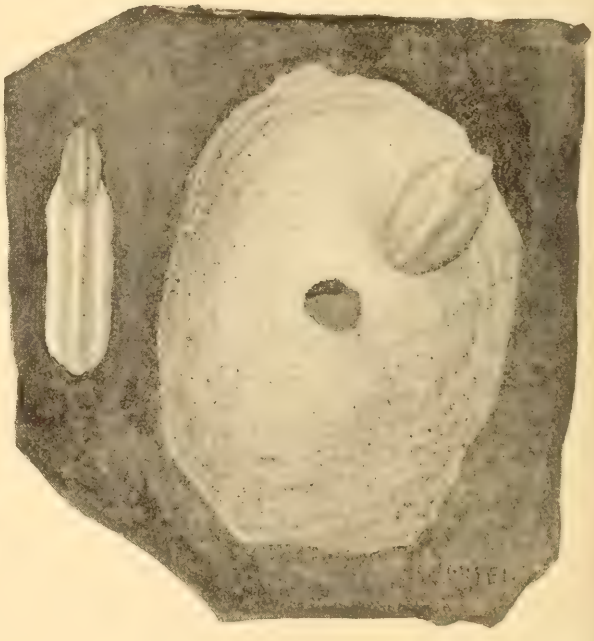

Fig. 5 Male and female rose scales much more enlarged

The middle of May 1901, infested twigs were received from Concordville, Pa., on which were gravid females, eggs and issuing males. Dr John B. Smith states that this species may winter in New Jersey in any stage from egg to gravid females, while we have at hand specimens from Ballston Spa taken in November 1910, showing both gravid females and eggs and indicating that this species probably winters in this condition. Office records show

that this pest has been received from Cornwall-on-Hudson, Poughkeepsie, Hudson, Castleton, Ballston Spa, Cobleskill and Brighton near Rochester. Young were appearing in considerable numbers on the material received from Hudson in early June and the same was true of specimens from Cobleskill collected October 18th. This species begins to breed in New York State the latter part of May or in June and apparently produces young in greater or less numbers throughout the season, though Professor Smith believes that there are not more than three generations in New Jersey. Material collected in New York State showed the presence of several parasites, Arrhenophagus chionaspidis Aur., while Professor Toumy has reported the rearing of Aphelinus diaspidis How. from this species.

This pest, as was observed by Professor Smith, is very likely to be abundant in sheltered, shady situations, especially beside buildings. It can be controlled best by thorough spraying in the spring at the time the reddish young appear, with a whale oil soap solution, using about one pound to six or seven gallons of water and repeating the applications at intervals of a week or ten days, so long as the abundance of the pest appears to justify the treatment. A kerosene emulsion, the standard formula diluted with at least nine parts of water, should be equally effective.

Greenhouse leaf-tyer (Phlyctaenia rubigalis Guen.). The pale green, rather slender, black spotted caterpillars of this species were brought to our attention in October by John Dunbar, Assistant Superintendent of Parks, Rochester, N. Y. because of their feeding upon the underside of chrysanthemum leaves. He found that they also attacked geraniums and some other plants. Mr Dunbar attempted to control the species with applications of hellebore, nicotine and even by fumigation, using one ounce of cyanide of potassium to 5000 cubic feet of space without apparent results, though this last named treatment is an effective check upon the white fly.

This insect has been known in entomological literature by several names. It was first described by Guenee in 1854 as Scopula rubigalis, while other authors published descriptions of this form under the names of Botys oblunalis Led. and Botis harveyana Grote. This species has been assigned to other genera such as Margaritia, Pyrausta and Pionia. It has been frequently discussed under the name of Phlyctaenia ferrugalis Hübn., a nearly cosmopolitan, world-wide form distinct,

according to Hampson, from the species we are considering. This latter appears to be widely distributed in North America, having been recorded in localities from the Atlantic to the Pacific coast and from Keywest north into Canada. It appears in its northern distribution at least, to be preeminently a greenhouse species.

The reddish brown and indistinctly black marked moth has a wing spread of about three-fourths of an inch. The fore wings are a variable yellowish brown with indistinct, serrate, blackish lines and spots. The hind wings are grayish and mostly indistinctly marked, both wings being margined by a row of rather distinct black spots. When at rest the hind margins of the posterior wings touch and the moth has a flattened, triangular shape.

The full-grown caterpillar is about three-fourths of an inch long, green or greenish yellow in color and somewhat transluscent. The head is light amber with obscure, pale brown, irregular markings, the first thoracic segment usually with a subdorsal pair of small, black spots, or the cervical shield may be transparent. The remainder of the body has a broad, greenish white dorsal stripe extending to the subdorsal region, with the darker alimentary tract showing through. This stripe in some individuals is whitish transparent and margined by narrow, white, subdorsal lines. The sides are pale yellowish green. The tubercles are small, piliferous, semitransparent and shiny. Anal segment with a subdorsal pair of small, irregular, black spots. The true legs are yellowish transparent, the prolegs semitransparent.

This caterpillar is a very general feeder, having been recorded by various writers as attacking celery, cabbage, beets, tobacco, Ageratum, geranium, ground ivy, German and Kenilworth ivy, violet, heliotrope, wall flower, wandering Jew, dahlia, daisy, Justicea, chrysanthemum, carnation, Cineraria, begonia, abutilon, roses, anemone, nasturtium, moon vine, Swainsonia, Genista, Plumbago, Matricaria, Passiflora, Ruellia, Tydaea, Lobelia, Veronica, Lantana, Deutzia, nodding thistle (Carduus), Ambrosia, several species, and Sisymbrium.

These somewhat general feeders are most noticeable in secluded situations and display a marked preference for the terminal leaves, eating holes in the latter. They feed chiefly at night, resting by day in one location, a retreat in which the final transformations usually occur. The duration of the larval existence extends from about three to possibly five weeks, and that of the pupa from one to presumably two weeks. It will thus be seen that several genera-

tions annually may be produced in greenhouses, considerable depending upon the conditions.

The experience of others as well as that of Mr Dunbar, cited above, shows this insect to be quite resistant to insecticides, such as hellebore, tobacco extracts, or fumigation with hydrocyanic acid gas. It is very probable that judicious and early under-spraying with a poison, particularly arsenate of lead, would prove an important means of controlling this pest. Such treatment is, as a rule, objectionable in greenhouses because of the accompanying disfiguration of the foliage.

Systematic hand picking, in connection with other work and including the destruction of the moths when at rest in a greenhouse, is perhaps as effective as any control method. This should be supplemented by isolating infested plants wherever noted and taking special pains to destroy all the insects thereupon before they are returned to the benches. Prevention of infestation is by all means the most satisfactory, and we would urge the exercise of great care to see that greenhouses are stocked in the fall with plants uninfested by this pest. There is always the possibility of moths of this species entering ventilators or doors in early fall. A careful watch should be kept for such infestations and should they occur great care exercised to destroy the caterpillars before the pest becomes abundant enough to cause serious trouble later in the season.

An extended account of this species, with references to other literature is given by F. H. Chittenden in Bulletin 27, new series, Division of Entomology, United States Department of Agriculture, from which certain of the above statements have been taken.

Wheat wireworm (Agriotes mancus Say). This common wireworm is best known because of its depredations upon wheat, its injuries being particularly severe in the Middle States. Mr Purley Minturn of Locke forwarded specimens and reported under date of May 20, 1910 that this pest had been quite injurious to oat fields in his vicinity, entirely ruining some. He adds that all badly infested fields had been in meadow for five years or more and were sown to buckwheat last year and to oats this spring. This species has also been recorded as injuring corn and potatoes.

The slender, tapering, brownish, slightly hairy parent insects, instantly recognized as click beetles or snapping beetles, occur in June. They are of a dark, waxy, yellow color and not readily differentiated from other numerous, very similar allies. The destructive form or larva of this species may be easily distinguished

from other wireworms by the pointed posterior extremity and especially by the two dark brown or black pits on either side of the last segment and almost touching the preceding segment. These wireworms, when full grown, are from about one and one-fourth to one and one-half inches long, waxy, yellow, slender and hard. The parent insects presumably deposit their eggs near the roots of grasses and the young hatching therefrom require three years to complete the life cycle. The transformation to the delicate pupa occurs within an earthen cell in late summer or early fall, the beetles emerging the latter part of the following May or during June.

Owing to the hard, chitinous covering of the wireworms, they can not be readily destroyed by the application of insecticides of any kind. Their subterranean habits and preying upon field crops of comparatively small commercial value, also increase the difficulties of satisfactorily controlling the pests. Destructive wireworms are most likely to be abundant in sod, particularly that which has been seeded for some time, and it is therefore unwise to plant on badly infested sod crops liable to serious injury. Should the latter be necessary, something can be accomplished by plowing in early fall, since this process destroys the delicate pupae in their hibernating cells. Experiments have shown the practicability of killing the parent click or snapping beetles by the judicious use of poisoned baits, such as clover or lettuce dipped in strong paris green water. This can be done successfully only in midsummer, at the time the parent insects are abroad, and should be continued so long as numbers of beetles are attracted to the bait. Unfortunately, these measures are of no immediate service in a field badly infested by the pest. Prof. H. T. Fernald, as a result of certain experiments, provisionally recommends tarring corn and then placing the same in a bucket containing fine dust and paris green mixed in such proportions that the corn, after being shaken up in the bucket, shows a greenish color. Such corn feeds through a seeder without difficulty and in the experiments came up satisfactorily, while check rows were badly injured. Examinations later showed that the wireworms were present close to the seed but that they did not molest the seed itself, apparently being repelled by the application. It is by all means advisable, as pointed out above, to avoid trouble, if possible, by planting on land free from these pests those crops which can not be protected. A rotation of crops will do much to prevent this pest becoming unduly abundant, since it is primarily a grass-feeding species and requires some three years to complete its life cycle.

Harlequin cabbage bug (Murgantia histrionica Stal.). This insect, though well known as a common and injurious pest of cruciferous plants in the South, is rare in the northern states. Dr John B. Smith, in his list of Insects of New Jersey, published in 1899, reports its occasional presence in destructive numbers in southern New Jersey. We find on referring to our records, that in the report of this office for 1900 this species was reported from Elmira and Oswego, and Jamaica, L. I., the two latter localities being brought to our notice through the courtesy of Dr L. O. Howard. The past summer specimens of this bug were received from Mr Roy Latham at Orient Point, the extreme eastern end of Long Island. This latter record is interesting, showing the continued presence of the insect on Long Island and its extension over practically all of that section. It is hardly probable that this species will ever become abundant enough in New York State to cause material injury.

SHADE TREE INSECTS

Elm leaf beetle (Galerucella luteola Müll.). This pest continues to attract a great deal of notice on account of its serious depredations, especially in the Hudson valley. Numerous trees almost defoliated or with badly skeletonized leaves were rather common in the cities and villages of the valley from New York city northward to Stillwater and vicinity. A noteworthy feature was a report of serious injury accompanied by numerous specimens received from Mr Frank T. Clark of Ticonderoga. This appears to be the northermost record for the occurrence of these beetles in numbers in New York State. The injury by this pest was severe in the Mohawk valley at Schenectady and locally at Amsterdam. The elms of Ithaca, judging from reports received, have also been seriously injured.

The season of 1910 has been remarkable in the Hudson valley because of the prolonged drought following a scarcity of water the preceding season. This condition undoubtedly had an important influence upon the thrift of the trees, a fact easily demonstrated by examining elms where there were practically no elm leaf beetles. The foliage on many of these trees was thin and, though not skeletonized, was in a far from satisfactory condition. As a consequence, trees suffering from drought and exposed to a further depletion of energy through the attacks of a voracious leaf feeder, were more seriously affected than usual by this latter injury. Many trees will go into the winter with a reduced vitality, and it is to be

expected that considerable dead wood will be found another spring. All such trees should receive special attention next season. The dead wood should be removed and this possibly supplemented by judicious pruning, the exposed cut surfaces being protected from the weather by applications of tar, paint or similar materials.

Most important of all, these trees should also be protected from the continued ravages by the elm leaf beetle. Experience has demonstrated time and again the entire practicability of controlling this pest by thorough and timely applications of an arsenate of lead (15 per cent arsenic oxide) to the under surface of the foliage at about the time the leaves are three-quarter to full grown, something depending upon the number of trees to be treated. The most effectual spraying for this pest must be done between the middle of May and the 25th of June. It is practically useless to apply poison after the grubs commence to forsake the trees unless the foliage has been so thoroughly skeletonized that the majority of the leaves will drop and a new crop appear. Spraying for the protection of this new foliage is always justified by results, and the late applications may also be of service in protecting foliage which had escaped injury earlier in the season. There are three important factors to be observed in this work if one would secure satisfactory results; namely, timeliness, the securing of proper material and its thorough application to the under surface of the leaves. Inattention to any one of these details will result in unsatisfactory work, if not in a complete failure in the efficacy of the operations. Our modern high power spray apparatus makes it possible to treat such trees rapidly and without great expense. These methods, if carried out faithfully, should insure practical immunity from serious injury and enable the elms to regain some of their normal vigor. It is perhaps unnecessary to add that so far as the elm leaf beetle is concerned, the application of sticky bands to the trunks of the trees, or the scraping off of the rough bark, are of so little value as not to deserve serious consideration at the hands of the practical man.

Bag worm (Thyridopteryx ephemeraeformis Haw.). Numerous half grown larvae of this species were received June 3, 1910 from Mr M. C. Albright, who took them at New Baltimore. This, as has been previously pointed out, is near the northern limit of this species.

Sugar maple borer (Plagionotus speciosus Say). The presence of this pernicious borer at Fulton was recorded in our report for last year. An examination the present season

shows that the destructive work has continued without abatement, there being several centers of infestation. One is near the northwest corner of the park and is marked by a nearly dead maple tree having a trunk diameter of about 18 inches and showing approximately fifty of the characteristic exit holes, some of them being a year or more old. There has been a spread from this center of infestation upon either side and the existence of adjacent trees is threatened. Several similar centers were found on Cayuga street, namely, a row of four dead or dying magnificent trees between Second and Third streets, another on South Third street beside the church facing Cayuga street, and a fourth at the corner of Cayuga and Fourth streets. The above probably represents only a portion of the maples seriously affected by this pest. A complaint accompanied by specimens shows this insect to be destructive to the sugar maples at Carthage, and at Palmyra.

Elm scurfy scale (Chionaspis americana Johnson). This species is more or less abundant upon elms throughout the State. A very badly infested limb was brought in May 10, 1910 by Mr W. B. Landreth of Schenectady, with the statement that the tree, set some twenty years previously, and with a trunk diameter of about 15 inches, was in poor condition. Last year many of the young leaves dropped when they were partly out and another crop developed. The tree is said to be in a somewhat better condition this year, though apparently far from vigorous. Judging from the specimen submitted, this scale insect appears to be responsible for the major portion of the injury, since the twig is well spotted with scales and numerous crawling young are to be seen upon the bark.

False cottony maple scale (Phenacoccus acericola King). There has been an unusual number of complaints concerning this insect, the majority coming from Mt Vernon and vicinity, though reports of injuries were received from Newburgh and Batavia. Personal observation showed that this pest was somewhat abundant on trees at Newburgh and, to a less extent, at Hopewell Junction.

This species is easily distinguished from the older and better known cottony maple scale[1] by the fact that it occurs in conspicuous felted masses upon the trunks of infested trees and also forms large, cottony aggregations on the foliage (fig. 6), two situations where the cottony maple scale is never found with its contrasting white covering.

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[1] Pulvinaria vitis Linn.

The full-grown females of the false maple scale may be found on maple leaves in summer and are then about one-quarter of an inch in length and with a slightly less transverse diameter. The parent insects are concealed by an oval mass of powdery, slightly stringy wax within which is the female and her eggs (frequently 500 in number), the former occupying the anterior portion and her

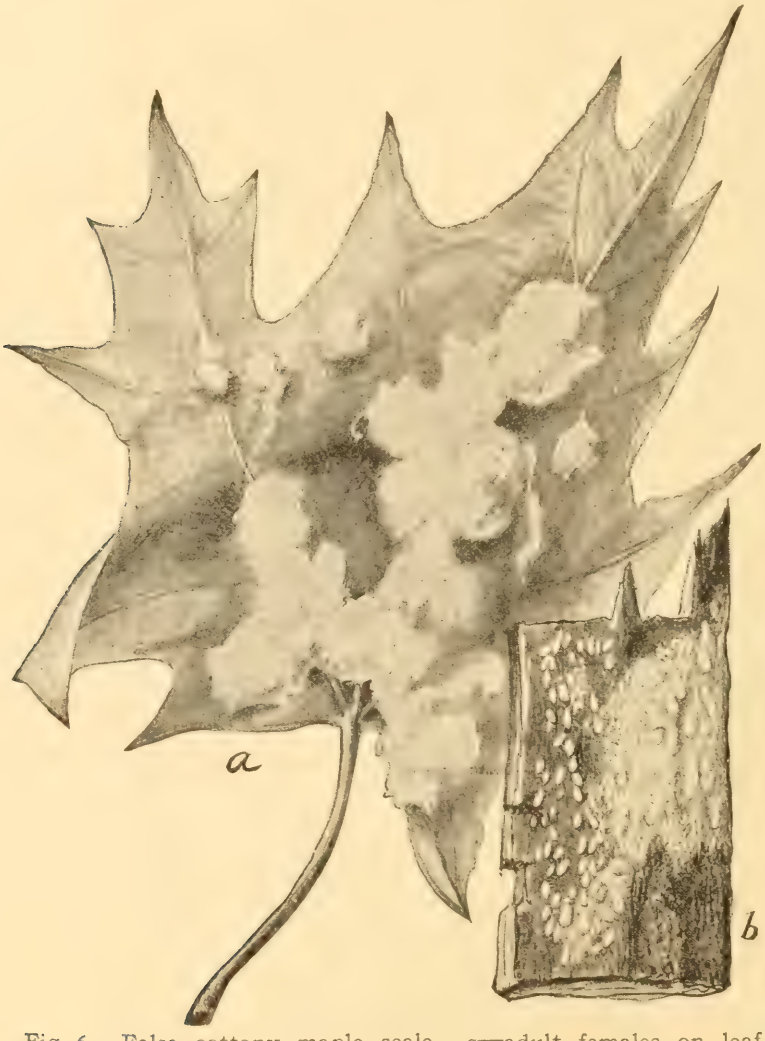

Fig. 6 False cottony maple scale. *a*=adult females on leaf; *b*=young females and males on bark. Natural size. (After Howard. Insect Life. 1894. 7:235)

body constituting about one-quarter the bulk of the mass. The young remain on the leaf after emerging from the eggs, unless it is too crowded, in which event they crawl down the petiole and seek nourishment on healthy foliage. The males, on attaining full growth, become restless and wander over the trunk and limbs for from seven to ten days, finally secreting themselves beneath or

upon the rougher outer bark, form the conspicuous felted masses frequently seen, and therein transform to pupae. There are probably three generations in this latitude, the winter being passed by the young in crevices of the larger limbs. Observations at Poughkeepsie last fall showed that crawling young were very numerous October 4th. Affected trees drop their foliage earlier in the fall while that of others is still green and at least moderately vigorous.

This scale insect can be controlled by thorough applications, in winter or early spring, of a contact insecticide, using 1 pound of whale oil soap to a gallon of water. The kerosene emulsion, the standard formula diluted with 4 parts of water, has been found very effective in controlling the cottony maple scale and would doubtless prove equally efficient in the case of this species. Several oil preparations now on the market under various trade names have also been employed successfully.

FOREST TREE INSECTS

Large black carpenter ant (Camponotus herculeanus Linn.). The work of this large wood ant is rather common in the Adirondacks where it appears to display a marked partiality for balsam trunks, excavating them in a very characteristic manner as illustrated and pointed out by the author several years ago.[1]

An examination of the balsam shows at once that the ants had eaten out the softer portions of the wood, and left in large measure the harder parts formed toward the end of the season when growth was comparatively slow and the wood correspondingly firmer. This style of galleries was also compared with the very irregular and markedly different work of this species in elm. The latter is undoubtedly due to the fact that the fibers of elm wood interlace and, as a consequence, there is very little difference in the relative hardness of the wood laid down at different seasons of the year. The past season we secured from Silas H. Paine of Silver Bay an exceptionally fine specimen of the work of this species in poplar. By reference to plates 19, 20, it will be seen that the method of excavation is somewhat intermediate between that obtaining in poplar and the elm and presumably explainable by the nearly uniform, soft texture of poplar wood. The general plan shows a series of horizontal chambers connected by numerous more or less regular, perpendicular galleries traversing the heartwood. Portions of the galleries strikingly suggest the ruins of an ancient castle. This ant

[1] 1905 N. Y. State Mus. Mem. 8, 1: 90, pl. 31.

occasionally establishes itself in houses and, if allowed to multiply unrestricted, may seriously weaken the timbers.

Abbott's pine sawfly (Lophyrus abbotii Leach). This rather common and occasionally destructive species was unusually abundant in the foothills of the Adirondacks last summer. This insect was reported as defoliating pines in August, by Mr Andrew Lackey of Johnsburgh and by Messrs Wesley Barnes and J. W. Wilson of Olmstedville. Mr Lackey stated that the insects had injured quite a number of his pines, while a personal examination showed that this sawfly was abundant on a comparatively few trees at Olmstedville, being restricted to some 40 or 50 pines in the creek bottom. One of these trees was nearly 50 feet high and so badly injured that practically all the foliage was destroyed, while at its base were to be found thousands of half-grown larvae unable to secure nourishment necessary to the attainment of their normal growth. Many cocoons were observed in the needles at the base of this tree August 9th and 10th. None appeared to be of normal size, since they were from one-third to even one-fourth smaller than cocoons made by larvae received early in August from Mr Lackey. The other affected pines at Olmstedville were all small, rarely more than 25 or 30 feet high and none of them were so badly injured as the one described above. In some instances there were numerous full-grown larvae, specimens of which were secured. It was also stated that this insect was at work on near-by pines, though a cursory examination revealed no evidence of their operations. There were signs here and there of pines being injured, presumably by this insect, along the line of the Delaware and Hudson Railroad running from Corinth to North Creek. Rev. G. H. Purdey reported under date of August 22d, similar injury here and there to pines in the vicinity of Warrensburgh. No adults developed last season from the cocoons collected in August. There appears to be but one generation annually.

The destructive caterpillars, when full-grown, are nearly an inch long and easily recognized by the black head and the yellowish white body ornamented with two rows of oblong, square, black spots down the back. On each side there is another row of about eleven black, nearly square spots, a little longer than broad. These false caterpillars, when disturbed, throw back the head and move the upper portion of the body in a manner very similar to that of caterpillars belonging to the genus Datana. The larvae spin their brownish, oval cocoons among the leaves. Dr Riley states that some of the

flies appear early in spring, while others do not issue till the latter part of June. One parasite, Limneria lophyri Riley, has been reared from this sawfly. This species may occur upon both white and hard pines from midsummer till late fall. The parent insects deposit their eggs in little slits in the leaves. They are rather stout, 4-winged sawflies, the common name being given because of the sawlike appendage at the tip of the female abdomen. This sex has a wing spread of about two-thirds of an inch, is honey-yellow, the head and thorax being a little darker, the latter and the abdomen being slightly marked with black. The male has a wing spread of about one-half of an inch, and the body is black, except the yellowish underside and the tip of the abdomen.

Experience has shown that this species is most likely to injure young pines, consequently it is well, where feasible, to watch for the appearance of the pests in such plantings and if circumstances warrant, adopt repressive measures. Many larvae can be jarred from small trees by vigorous shaking and their ascent prevented by an application to the trunk, of a sticky band such as tree tanglefoot. There is no doubt but that thorough spraying with a poison, preferably arsenate of lead (15 per cent arsenic oxide) would destroy these leaf feeders. It might pay to resort to such practices where only a few trees are badly infested, largely for the purpose of reducing the likelihood of more extended subsequent injury.

Spotted Cornus sawfly (Harpiphorus tarsatus Say). This greenish yellow, black spotted sawfly was received September last from Joseph H. Dodge of Rochester, through the State Department of Agriculture, accompanied by the statement that the larvae were very abundant and destructive to Cornus mascula. This sawfly appears to be a rather common form and widely distributed, since it has been recorded from Canada, Massachusetts, Connecticut, Indiana and West Virginia. The eggs, according to Dyar, are deposited under the lower epidermis through a slit cut from above. They are close to the midrib in a long line, the cuts united. One edge of the swelling is on the midrib or large vein, the other parallel to it but wavy and composed of numerous saw cuts. The recently hatched larva is nearly colorless, with a slightly fuscous head. The latter becomes darker as development progresses and eventually black, while the body remains whitish or pale olivaceous, the black marks appearing in the sixth stage. The following description was drafted from full-grown living larvae:

Larva. Full-grown. Length 2.5 mm. General characters: head black, body greenish yellow with subdorsal and sublateral rows of black spots, venter orange-yellow.

Head subglobose, shining black, the single ocellus on each side, black. Antennae with the basal segment whitish transparent, the four distal segments with a yellowish tinge. Labrum yellowish; mandibles reddish basally, shining black apically; maxillary palpi, labium and labial palpi whitish transparent. Body segments 6 annulate dorsally, the first thoracic segment with the anterior two or three annulae mostly yellowish or yellowish orange; dorsum mostly yellowish green. The subdorsal row of black spots is composed of two on each segment, the anterior one extending over three annulae, the posterior on two, the first being approximately subquadrate, the second transverse and with a length nearly twice its width; the lateral row composed of large, irregular, quadrate spots, one to each segment and extending over four annulae. Anal plate with submedian, quadrate, black areas anteriorly and a median, quadrate, black area posteriorly, the remainder yellowish. Spiracles oval, brownish black, the subspiracular and ventral area orange-yellow; true legs pale yellowish, slightly fuscous apically; prolegs on abdominal segments 2 to 8 and 10.

The parent sawfly has been described by Norton[1] as follows:

Length, male, 0.32. Br. wings 0.52 inch. Length, female, 0.60. Br. wings 1.12 inch.

Female and male. Body long and stout; antennae longer than base of thorax, stout, flattened, serrate, black, with the four apical joints white; head as in E. varianus, with the sutures at sides of ocelli widened below and inclosing the base of antennae; nasus deeply incurved, rugose; labrum white, its edge rufous; tegulae piceous or yellow; scutel in middle white; legs black; all the trochanters, the apical half of four anterior tibiae and their tarsi and the posterior tarsi, except first joint, white (sometimes the first joint also). Wings smoky hyaline, base of stigma white; second recurrent nervure a little removed from intersection of second and third submarginals.

Blue Cornus sawfly (Harpiphorus versicolor Norton). Numerous specimens of these sawfly larvae were received from Dr L. F. Rinkle of Boonville, September 18th, accompanied by the statement that they had entirely stripped one bush of Cornus alternifolium. This sawfly appears to be less abundant than the preceding, having been recorded from Illinois and New Jersey. The eggs, according to Dr Dyar, about three in number, are laid side by side under the lower epidermis from above forming a short row nearly parallel to a side vein. The young larva has a pale brown head and a curled, whitish body, the latter becoming well covered with a white, mealy secretion in the third stage. The following description of the full-grown larva was drafted from living specimens.

[1] 1867 Norton, Edward. Amer. Ent. Soc. Trans. 1:231.

Larva. Full grown. Length 2 cm. This species is most easily recognized by the black head and the mostly black, transversely blue-banded dorsum, the ventral surface being orange-yellow.

Head shining black, the one lateral ocellus brownish black. Antennae short, fuscous yellowish, ventral fourth of head mostly fuscous yellowish including the labrum. Mandibles brownish black apically; labium, maxillary and labial palpi fuscous yellowish. Body segments irregularly 6 annulate dorsally, the first thoracic segment with the anterior two or three annulae orange-yellow, the others with the first three and the fifth annulae shining black, the fourth being light blue dorsally and subdorsally, black laterally and the sixth light blue. Anal plate black and with a few short spines or hairs. Spiracles oval, brownish black, the subspiracular area and venter orange-yellow; true legs yellowish transparent, fuscous apically; prolegs on abdominal segments 1 to 7 and 10.

The parent insect has been described by Norton[1] as follows:

Length 0.40. Br. wings 0.80 inch.

Female. Body long and not very stout, color chestnut-red; antennae not longer than base of thorax, thick, serrate beneath, third joint but little longer than fourth, the two basal joints piceous, the three next black, remainder white; face as in E. varianus, not so much depressed below antennae; clypeus not deeply notched; a black spot from below antennae to summit; labrum and tegulae white; thorax black, scutel black, basal plates rufous, legs rufous, trochanters and tarsi white; coxae, basal tip of the four anterior femora and the apex of posterior tibiae blackish; wings smoky, base of stigma white; second recurrent nervure a little removed from junction of first and second submarginal cells.

Spotted pine weevil (Pissodes notatus Fabr.). Seedling pines shipped from Oudenbosch, Holland and submitted for examination April 13, 1910 through the State Department of Agriculture, had the terminal shoots infested by a number of active, though full-grown larvae of this species. Pupation occurred shortly thereafter and several adults were reared in early May. The operations of this European form were very similar to those of the common American white pine weevil, Pissodes strobi Peck, though in this instance at least, there was a marked difference in the life history, since this imported insect appears to winter as a larva.

This European species, kindly identified by Dr A. D. Hopkins of the United States Bureau of Entomology, is about one-third larger than our native Pissodes strobi Peck and is most easily distinguished therefrom by the indistinct ochreous red coloration and the smaller, more inconspicuous, whitish spots on the distal

[1] 1867 Norton, Edward. Amer. Ent. Soc. Trans. 1:230.

third of the wing covers. Dr Hopkins states that this weevil is a very important enemy of the pine in Europe, and that owing to the danger of its becoming a serious pest in this country, every precaution should be adopted to prevent its obtaining a foothold in America. In passing, we would call attention to the fact that Ratzeburg has recorded 29 species of parasitic Hymenoptera living at the expense of this weevil. Nevertheless, it would certainly be much safer to exclude seedling pines, particularly as there is also grave danger of importing a very destructive fungous disease.

Snow-white linden moth (Ennomos subsignarius Hübn.). This insect, which has come into prominence during the last three years on account of its extended depredations in the Catskills and, to a lesser extent, in the Adirondacks, was again abundant in at least limited sections of the Catskills. A number of eggs of this species were brought in March 28th by Mr Edward Thomson of Frost Valley, Denning, Ulster county, accompanied by the statement that they were numerous in his vicinity. Mr Edmund Platt of Poughkeepsie stated, under date of July 16th, that the caterpillars of what were undoubtedly this species, were very abundant just southeast of Shokan, also in Ulster county, at an elevation of about 2000 feet. The foliage was badly eaten and the caterpillars were observed hanging from the leaves in every direction. Evidently they had cut off many leaves, pieces of which were strewn on the ground. Beeches, maples, moosewood and apparently every variety of forest tree in that vicinity, were eaten. The caterpillars were so thick as to make it very disagreeable walking through the woods. There were a few at lower elevations and again near the top of the mountain. Miss Maud M. Meyer stated, under date of July 20th, that the maple trees in the vicinity of Bushnellsville, Greene county, were being destroyed by caterpillars, undoubtedly this species. A specimen of the moth was transmitted by Dr James C. Ayer of Glen Cove, under date of July 22d, this gentleman fearing it might be the much more dangerous brown tail moth. This report from Long Island shows that the insects were probably somewhat abundant there, while personal observation disclosed the fact that they were to be found in small numbers July 22d at Milton and Marlborough, and also on the electric cars at Hudson and near Valatie. Apparently this pest is less numerous than it was last year and it is to be hoped that natural enemies, birds in our estimation occupying a prominent place in this respect, will soon reduce their numbers so greatly as to prevent extensive injury in the future.

There should be no difficulty in distinguishing this species from the brown tail moth mentioned above. The parent insect is a rather slender-bodied, usually snow-white moth (pl. 21, fig. 2) having a wing spread of about one and one-half inches, the female being a little larger. It is decidedly more slender than the brown tail moth and the latter, though flying at about the same time, may be instantly recognized by the characteristic bright reddish brown tuft on the tip of its abdomen.

The eggs of the snow-white linden moth are deposited in irregular masses (pl. 21, fig. 1) about half an inch in diameter, each containing from 50 to over 100 eggs. The individual eggs lay at an oblique angle to the supporting surface, are about 1 mm. in length, barrel-shaped, light brown and with a conspicuous salmon-colored ring at the extremity.

The full-grown caterpillar has a length of about two inches. The head is a dull reddish or yellowish brown, distinctly broader anteriorly, the clypeus sunken, yellowish brown, the labrum pale yellowish with a few conspicuous yellowish setae, while the antennae are short, the basal segment yellowish, the second segment prolonged, reddish yellow, narrowly yellowish at the extremities and with a few coarse setae apically. The mandibles are reddish brown, fuscous apically and irregularly bidentate; labial palpi triarticulate, mostly pale yellowish; spinneret concolorous. The thoracic shield is darker than the head and distinctly fuscous along the margins. The body is mostly a dull brownish black, the anal plate and the anal prolegs being yellowish brown. There are irregular, yellowish markings along the sublateral lines, they being represented by inconspicuous dots on the second and third thoracic segments. These markings are so thick on the first abdominal segment of some specimens as to give the appearance of short sublateral lines extending most of the length of the segment. On the third abdominal segment the yellowish markings are distinctly produced laterally and toward the median line, forming a pair of submedian irregularly oval, yellowish marks very suggestive of tubercles. These sublateral marks are indicated on the remaining segments only by inconspicuous dots, a pair on the anterior and posterior annulets of each segment, the yellow markings becoming a little thicker and more irregular on the 11th, 12th and 13th segments.

The true legs are a variable yellowish and reddish brown, the distal segments being somewhat darker. The first pair of prolegs are dark brown basally and yellowish brown apically; the anal prolegs are mostly yellowish brown; the venter is nearly the same color

as the dorsum, except that part between the prolegs which is variable yellowish green and yellowish brown.

The pupae occur among the leaves, being sheltered in very light, thin, yellowish brown cocoons. The pupa is about one inch long, the general color being a yellowish brown irregularly spotted with black. The antennae, legs and wing sheaths are closely fused and extend to the tip of the fourth abdominal segment; the terminal segment is pale yellowish or yellowish straw; the cremaster is composed of an irregular group of four stout, dark brown, recurved hooks, two distal, two subapical and then two pair of more slender ones, the more distal being lateral and the others dorsal.

Control measures. This species, as stated before, is not an important shade tree pest, since the English sparrow can usually be relied upon to keep it within bounds. The control of this insect in woodlands is a much more serious problem and must depend in large measure upon natural enemies, such as parasites and especially our native insectivorous birds. These latter should be protected in every feasible manner.

Birch leaf skeletonizer (Bucculatrix canadensisella Chamb.). This small leaf feeder was generally abundant, though not exceptionally numerous, upon the white birches at Kinderhook. This occurrence is probably the western border of a severe outbreak in New England, recently recorded by William R. Thompson[1] and comprising areas in Connecticut, Massachusetts, New Hampshire and Maine, at least. Nine years ago this species was exceedingly numerous in the vicinity of Albany, skeletonizing practically all of the foliage of our ordinary white or gray birch, Betula populifolia. The full-grown caterpillar is only about one-fourth of an inch long, light green or yellowish green and most easily recognized in association with the peculiar, oval or circular, whitish, moulting cocoons about one-twelfth of an inch in diameter. The larvae may be found upon the trees in August or early September, feeding upon the soft parenchyma of the leaf and, when numerous, skeletonizing the foliage. The winter is passed in a narrow, brownish yellow, ribbed cocoon about one-fifth of an inch long. The parent moth is a delicate, bright brown insect with a wing expanse of three-eighths of an inch. The wings have two subtriangular blotches on the inner margin which, when these organs are closed, form two white dorsal saddles, while, in addition, there are three silvery white bars which run from the outer edge about half

[1] 1910 Journ. Econ. Ent. 3:436.

vay across the wing obliquely toward the apex. Behind the nterior white saddle there is a tuft of raised, black scales and everal similar ones at the apex of the fore wings. This species can ardly be considered as of much economic importance, since its food lant has very little commercial value.

Beech tree blight (Pemphigus imbricator Fitch). his rather common insect is easily recognized by the woolly plant ce or aphids occurring in masses on the under side of the limbs. his species is quite resistant to cold, since it was observed the tter part of October, 1903, after the temperature had been quite old and while an inch of snow was to be seen on adjacent hillsides. is a widely distributed species, having been reported from various arts of the State. It was undoubtedly this species which was eported by Dr D. B. Miller, Jersey City, N. J., under date of ctober 31st, as being abundant on the lower small branches of oung beech trees in Delaware county. Mr George C. Wood, writ- g from the Trenton camp grounds at Barneveld, Oneida county, ugust 22d, stated that they were having a great deal of trouble th the insect, adding that every beech tree was covered with it d that it was fast killing the branches. Mr Frank A. Schmidt of on, writing under date of September 14th, states that practically of the beech trees in that vicinity were affected by this pest. he insects were so numerous that the lower branches of nearly all e beech trees were completely covered with the white, woolly hids. These limbs seemed to have lost all vitality, since those lf an inch in diameter could be bent and twisted like a piece of pe.

The great abundance of this insect over so large an area appears be unusual for New York State. Owing to the fact that it occurs on forest trees, active remedial masures are ordinarily impracal. We must depend in large measure upon natural enemies. e of the most important of these is the caterpillar of a native tterfly, Feniseca tarquinius Fabr. The mother insect posits her eggs upon the twigs of beech, alder etc. in the midst colonies of woolly aphids. The caterpillars, upon hatching, spin hin web and devour many of the plant lice, completing their wth within thirteen days.

Silver fir aphid (Chermes piceae Ratz.). Nordmann's received from Europe the past season and submitted for examion by the State Department of Agriculture, were infested by hermes which was provisionally determined as the above named

species by Dr A. D. Hopkins of the United States Bureau o Entomology and the writer. An examination of the literatur shows that there may be a question as to the specific identity o this European form. We have used the above specific name an given illustrations of the insect (pl. 18, figs. 1, 2), since our materia was not sufficiently abundant to permit of an authoritative identifi cation. This form may prove, as has been stated in the case o at least one Chermes on fir, to be a synonym of Chermes funitectus Dref.

Apparently, this is the first record of the introduction of th species into America. A Chermes discussed under this name b Gillanders is recorded by him as very destructive to young silve firs, comparatively young specimens of Abies nordmanniana and even fairly old trees of Abies nobilis. He state that young silver firs in nurseries are often killed outright by th insect. The data at hand justifies us in considering this species dangerous form which should be excluded, if possible.

MISCELLANEOUS

Blow fly (Calliphora viridescens Desv.). Se eral larvae and two pupae of this species were received under da of July 30, 1910, from Mrs H. B. Reist of Schenectady, accompani by the statement that they had been found under a rug in a stu on the second floor of a new house. Subsequent correspondenc developed the fact that the rug had been sent a month earlier to vacuum cleaning establishment located over a stable. There appea to be no other probable explanation for the occurrence of the larv in this strange environment, other than that they may have work into the fabric from some adjacent nitrogenous material while the cleaning establishment, since the common blow fly larv as is well known, thrive in fresh or decaying flesh, cheese nitrogenous vegetables. The parent flies, kindly determined Mr D. W. Coquillett of the United States National Muse appeared August 10th. They are about one-third the size of more common blow fly, Calliphora vomitoria Li with a somewhat similar steel-blue or violet-blue abdomen, thou easily recognized by the grayish black thorax in marked contrast the duller black thorax of C. vomitoria. It is perhaps ne less to add that both of these blow flies are distinguished from rather slender, grayish banded, exceedingly common house fly their larger size, greater stoutness and violaceous coloring.

Stable fly (Muscina stabulans Fall.). This rather common fly was reared last May from larvae in bee comb found in association with a few small beetles which live in decaying animal matter. This record is not unprecedented, since, according to Dr Howard, this species has similar habits in Europe. The maggots of this fly usually occur in decaying vegetable matter, fungi etc., though they have been reported as living in cow dung, and Megnin records finding puparia in the mummified bodies of children. This species was captured at Washington several times on human excrement.

Saturnia pavonia Linn. One specimen of the dark reddish brown cocoon of this Bombycid was found on nursery stock at Rochester. The cocoon is 3.5 cm. in length, 2.5 cm. in diameter and with one end somewhat produced and partially open. The moth, which was easily reared, has a wing spread of 7.5 cm., is smaller than our well known Calosamia promethea Drury, and the coloring is mostly in shades of gray with distinct ocellate spots on both the anterior and posterior wings. There should be no difficulty in excluding this rather large species.

Insects and paper. Three years ago, through the courtesy of the A. T. de la Mare Printing & Publishing Company of New York, we received a large sheet of paper badly disfigured, though just from the calendering rolls. An examination showed that a May or June beetle had been caught in the heavy rolls and literally crushed into the paper, its body fluids making a smear some 12 inches long. A most interesting feature was the preservation of the hard parts, especially the legs and antennae, so perfectly that there was no difficulty in referring the victim to the genus Lachnosterna. An equally interesting specimen of this kind of work was discovered in a recent publication. The victim this time was a crane fly. The paper presented substantially (pl. 17, fig. 2) the same appearance as noted above, portions of the insect remaining even after the paper had been subsequently printed upon and bound. These accidents suggest the possibility of a novel ornamental card or sheet made by rolling into the paper the delicate wings of certain common insects, thus obtaining an effect impossible from purely artificial methods.

Agromyza melampyga H. Lw. Numerous specimens of this small, yellowish and black marked fly were reared the latter part of May 1910 from walking-leaf, Camptosorus rhizophyllus, collected at Hudson Falls May 16, 1910 by Stewart H. Burnham, assistant to the State Botanist. The infested leaves

presented a peculiar appearance at that time, since many of them were margined on the upper surface with a more or less linear series of equidistant, brownish elevations which, upon examination, proved to be the tips of the puparia. The larvae evidently live in communal mines and, when full-grown, cut a slitlike orifice and transform so as to leave the brownish bispinose apex of the puparia protruding from the orifice. A series of these presents an unique appearance. The puparium is about 2 mm. long, nearly 1 mm. wide, rather stout, a variable reddish brown, the exposed tip being a little darker. Apically there is a pair of dark brown, short, stout, chitinous, recurved processes. One parasite, kindly described through the courtesy of Dr L. O. Howard, by Mr J. C. Crawford as Sympiezus felti, was reared at the same time the flies issued.

The parent insect has been described[1] by C. W. Johnson under the name of A. flaviventris as follows:

Head light yellow, occiput black; antennae yellow, aristae black. Thorax light yellow, with a large black dorsal spot, which extends narrowly from the cervix, expanding dorsally, with lobes above the humeri and base of the wings; scutellum yellow, metatarsus black. Abdomen dull light yellow, terminal segment black; halteres and legs yellow. Wings grayish hyaline. Length of the larger specimen 2 mm.; the smaller one 1.5 mm.

These specimens were taken at Niagara Falls. It has been listed by Smith from New Jersey, recorded by Loew from the District of Columbia and identified from the Bahamas.[2] In addition this species has been reared at Washington, D. C., by Coquillett[3] from leaf mines in a species of cultivated Philadelphus and also from the common Plantain, Plantago major.

Coquebert's Otiocerus (Otiocerus coquebertii Kirby). The slender, yellowish or yellowish red marked insects belonging to this species and resembling somewhat in general appearance Caddis flies, are rather common and widely distributed, having been recorded from Canada, south to Texas and, in addition, from several Eastern and Middle States. The delicate adults have been taken upon a variety of trees, namely hickory, oak, beech, maple and also on grape.

This attractive insect belongs to the Hemipterous family Fulgoridae, noteworthy because of the large exotic lantern flies. The Brazilian Laternaria phosphorea has a wing spread of

[1] 1902 Can. Ent. 34:242.
[2] 1908 Psyche 15:80.
[3] 1898 U. S. Dep't Agric., Div. Ent., Bul. 10 n.s., p. 77.

fully 6 inches and an enormous miter-shaped head as long and nearly as thick as its body. The subfamily Derbidae to which Otiocerus is referable, is a group of moderate extent, comprising some of the most beautiful and delicate forms found in the Hemiptera. The head in this subfamily is generally produced forward, sometimes extremely compressed and with the sides prominently carinate as is the case with Otiocerus.

The adult of this species when at rest is nearly half an inch long to the wing tip (the length of the body is only three-sixteenths of an inch). It rests with the long, delicate wings folded together parallel and thus presents a general resemblance to a Caddis fly. It may vary in color from a nearly uniform, pale yellowish or yellowish green in the one female obtained to a yellowish green marked with strongly contrasting red or reddish brown in the males as follows: The broad stripe extends from the tip of the head on either side to the bronzy or blackish eyes, is continued by broken spots just below and behind these organs, and a larger, reddish area laterally on the pronotum and on the anterior portion of the mesonotum, and may be followed as an oblique stripe from the base of the fore wing to its posterior margin near the distal third, which latter is marked by a slight marginal fuscous line. From this point the reddish markings are produced in a more or less broken, marginal line to the anal angle, there being a small subapical branch near the distal fifth and a much more conspicuous one at the distal third and extending as an irregular, oblique mark to the anterior distal angle. There is, in addition, an irregular, reddish mark near the middle of the wing; the hind wings are nearly colorless. The head is strongly compressed, being greatly produced anteriorly and with strong lateral dorsal carinae. The male antennae are a variable reddish and remarkable, since each is composed of three irregular branches apparently arising from a basal segment, the anterior distinctly capitate. The antennae of the female are but two-branched, the anterior one slightly capitate and apically with a bristle nearly as long as the branch. The ovipositor is short, the organs uniting to form a conical apex. The legs are a nearly uniform yellowish transparent. The pale yellowish abdomen extends only to about the middle of the wings and is variously shaded with reddish. The male is easily recognized by the conspicuous pair of yellowish transparent, inflated, strongly curved clasping organs.

A colony of nymphs of this species were taken at Poughkeepsie, N. Y. May 12, 1910 under the dead bark of a stump, possibly beech. The insects moved slowly, and eleven days later adults emerged.

Nymph. Length one eighth of an inch, width about one-sixteenth of an inch. Color an obscure brown, the sutures yellowish brown; the head small, partially concealed by the prothorax; the wing pads short, extending to the third abdominal segment, each of the latter with a series of obscure tubercles, fuscous basally, lighter apically; along the anterior third the head and thorax apparently with similar though more rudimentary structures. Legs a yellowish brown.

It is remarkable that such an apparently large adult should develop from so small a nymph. A partial explanation is found in the fact that the abdomen of the adult is much shorter than one would be led to expect from the length of the wings.

PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1910. Fifty are given with title[1], time of publication and a summary of the contents of each. Volume and page numbers are separated by a colon, the first superior figure gives the column and the second the exact place in the column in ninths: e. g. 75:9[15] means volume 75, page 9, column 1 in the fifth ninth, i. e. about one-half of the way down.

Grain Weevil. Country Gentleman, Jan. 6, 1910, 75:9[15]

A summary discussion of repressive measures.

Two New Cecidomyiidae. Entomological News, Jan. 1910, 21:10–12

Lasioptera tripsaci and Cecidomyia opuntiae described.

Deformed Apples. Country Gentleman, Jan. 27, 1910, 75:82[16]

A brief discussion of the work of the tarnished plant bug, Lygus pratensis Linn. The plant louse outbreak of 1909 is commented upon and control measures discussed.

Corn, Cutworms and Ants. Country Gentleman, Feb. 3, 1910, 75:107[25]

A brief discussion of methods for controlling various cutworms and ants in cornfields.

Scale and Fungus Attacks. Country Gentleman, Feb. 3, 1910, 75:107[33]

The San José scale, Aspidiotus perniciosus Comst. is identified and remedial measures briefly discussed.

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[1] Titles are given as published and in some instances they have been changed or supplied by the editors of the various papers.

Observations on the House Fly. Economic Entomology Journal, 1910, 3:24–26

Summary of experiments showing that the house fly, Musca domestica Linn. does not invade darkened apartments.

Some Tree Crickets. Country Gentleman, Feb. 24, 1910, 75:182[27]

Oecanthus niveus DeG. appears to be limited mostly to apple trees, while O. nigricornis Walk. and O. quadripunctatus Beutm. have been recorded as the species injurious to raspberry and blackberry bushes. Preventive measures are discussed.

Control of Flies and Other Household Insects. New York State Museum Bulletin 136, 1910, p. 1–53 (Issued Feb. 26, 1910, a revised and extended edition of Bulletin 129).

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Work with the Codling Moth. Country Gentleman, Mar. 3, 1910. 75:230[11]

A summary comparison of results obtained against codling moth, Carpocapsa pomonella Linn., between coarse and fine sprays and one, two and three applications. One thorough application of a mist spray gave 98–99 per cent of worm-free fruit.

Struggle with the Scale. New York Apple Orchards Saved. Rural New Yorker, Mar. 5, 1910, 69:256[11]

A summary account of the work against San José scale, Aspidiotus perniciosus Comst., with special reference to the success of Mr W. H. Hart in his old orchard.

Bleeding Elm — Beetle. Country Gentleman, Mar. 10, 1910, 75:245[42]

Discusses the causes of bleeding in trees and gives remedy for the elm leaf beetle, Galerucella luteola Müll.

The Apple Maggot. Country Gentleman, Mar. 17, 1910, 75:271[25]

A general discussion of Rhagoletis pomonella Walsh, with reference to work against fruit flies in South Africa with poisoned syrups.

Spraying for Codling Moth. Country Gentleman, Mar. 31, 1910, 75:322[27]

A summary discussion of remedial measures for Carpocapsa pomonella Linn., with special reference to results obtained with the single spray and with observations on prepared insecticides.

Schizomyia ipomoeae n. sp. Entomological News, April, 1910, 21:160–61

A description of this West Indian species reared from the flower buds of Ipomoea.

Methods of Controlling the House Fly and thus Preventing the Dissemination of Disease. New York Medical Journal, April 2, 1910, 91:685–87

A summary account of the house fly, Musca domestica Linn., with special reference to control measures.

Oyster-Shell Scale. Country Gentleman, April 7, 1910, 75:347[15]

Remedial measures for Lepidosaphes ulmi Linn.

Spraying for the Codling Moth. Economic Entomology Journal, 1910, 3:172–76

Summary of experiments for the control of Carpocapsa pomonella Linn., and emphasizing the effectiveness of one thorough application of poison.

Leopard Moth. Country Gentleman, April 21, 1910, 75:396[45]

Brief economic account of Zeuzera pyrina Fabr., with special reference to control measures.

Peach Twig Borer. Country Gentleman, May 12, 1910, 75:470[32]

Summary economic account of Anarsia lineatella Clem.

Borer. Country Gentleman, May 26, 1910, 75:517[26]

A brief discussion of the peach borer, Sanninoidea exitiosa Say and methods of controlling it.

Cutworms in the Garden. Country Gentleman, May 26, 1910, 75:518[36]

A discussion of remedial and preventive measures.

West Indian Cecidomyiidae. Entomological News, 1910, 21:268–70

Cecidomyia manihot on Cassava, Camptoneuromyia meridionalis from flower buds of Ipomoea are described as new. The larva of Schizomyia ipomoeae Felt is also characterized.

Maple Leaf Aphis. Country Gentleman, June 23, 1910, 75:603[14]

A brief general account of Pemphigus tessellata Fitch on maple.

Beet Leaf Miner. Country Gentleman, June 30, 1910, 75:622[35]

A summary economic account of Pegomya vicina Lintn.

Flies in the Stable. Country Gentleman, June 30, 1910, 75:628[11]

A general discussion of the house fly problem, Musca domestica Linn., with special reference to stables and methods of preventing breeding.

Onion Maggot. Country Gentleman, July 7, 1910, 75:642[17]

Remedies for Phorbia ceparum Meign. are briefly discussed.

Apple Tree Borer. Country Gentleman, July 7, 1910, 75:642[37]

Brief discussion of remedial measures for Saperda candida Fabr.

Green Fruit Worm. Country Gentleman, July 7, 1910, 75:646[47]

Records injuries by a green fruit worm, Xylina antennata Walk., in New York State.

Beans Hurt by Maggot. Country Gentleman, July 14, 1910, 75:660[11]

A summary account of Phorbia fusciceps Zett., with special reference to remedial measures.

Flea Beetle. Country Gentleman, July 21, 1910, 75:682[26]

A brief practical account of Epitrix cucumeris Harr.

Corn Worm. Country Gentleman, July 28, 1910, 75:703[13]

Control measures for Heliothis armiger Hubn. are briefly outlined.

Maple Scale. Country Gentleman, July 28, 1910, 75:703[17]

A summary discussion of the cottony maple scale, Pulvinaria vitis Linn., with mention of the woolly Phenacoccus acericola King and the alder and maple plant louse, Pemphigus tessellata Fitch.

Plant Lice. Country Gentleman, August 4, 1910, 75:722[24]

General directions for spraying for plant lice or Aphididae.

25th Report of the State Entomologist on the Injurious and Other Insects of the State of New York, 1909. Education Department Bulletin. N. Y. State Mus. Bul. 141, 1910, p. 1–178, 22 pl. (Issued August 4, 1910)

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Malaria and Mosquitos in New York State. Atti della Societa per gli studi della malaria, vol. 9, 1910, Separate p. 1–12

Summary discussion of malaria in New York, with a brief notice of the malaria-carrying species, their breeding places, enemies and legislation in relation thereto. A brief account is given of the mosquito control work in the State.

The Elm Leaf Beetle. Country Gentleman, Aug. 11, 1910, 75:740[25]

A record of injury with a summary discussion of remedial measures for Galerucella luteola Müll.

Recent Observations upon European Insects in America. Economic Entomology Journal, 1910, 3:340–43

Notes are given on Pissodes notatus Fabr., Dichromeris marginellus Fabr., Hyponomeuta malinella Zell., Saturnia pavonia Linn., Monarthropalpus buxi Lab. and Chermes piceae Ratz., all recently brought into this country.

Gall Midges of Aster, Carya, Quercus and Salix. Economic Entomology Journal, 1910, 3:347–56

A tabulation of the American species of Cecidomyiidae occurring upon the above named plants — 46 being recorded on willow. A new genus, Asteromyia, is erected and two new species, Oligotrophus salicifolius and Dasyneura corticis, described.

Scientific Notes. Economic Entomology Journal, 1910, 3:381

Galerucella luteola Müll is recorded from Fort Ticonderoga and serious injuries are reported throughout the Hudson valley. Observations are presented on the work and flight of the snow-white linden moth, Ennomos subsignarius Hübn.

Red Spider. Country Gentleman, Aug. 18, 1910, 75:762[36]

A discussion of injuries and remedial measures.

Melon Aphis. Country Gentleman, Aug. 18, 1910, 75:764[12]

Remedial measures for Aphis gossypii Glov. are given.

Tree Spraying. Country Gentleman, Aug. 25, 1910, 75:789[15]

Observations on methods employed by "tree-protecting companies" and those of service in controlling elm leaf beetle.

Scale on Maple. Country Gentleman, Aug. 25, 1910, 75:789[26]

Putnam's scale, Aspidiotus ancylus Putn. is identified and spraying with a lime-sulfur wash advised where the scale is abundant.

Vermin in the House. Country Gentleman, Aug. 25, 1910, 75:800[21]

The bed bug, Cimex lectularius Linn. is briefly described and exterminative measures fully discussed.

Asparagus Beetles. Country Gentleman, Sept. 8, 1910, 75:840[24]

Arsenical applications, preferably arsenate of lead, are recommended for the control of both species of asparagus beetles, Criocerus asparagi Linn. and C. duodecimpunctata Linn.

Tulip Scale. Country Gentleman, Sept. 8, 1910, 75:840[32]

Spraying with contact insecticides in early September to destroy the young of Eulecanium tulipiferae Cook is advised.

Harvest Mites. Country Gentleman, Sept. 8, 1910, 75:840[37]

The life history of this pest is briefly sketched and methods of avoiding infestation and allaying the irritation following an attack given.

Woolly Aphis. Country Gentleman, Sept. 8, 1910, 75:840[42]

Remedial measures are given for the woolly aphis, Schizoneura lanigera Hausm. and also for the scurfy scale, Chionaspis furfura Fitch.

Horticulture: Diseases and Pests. New York State Education Department. Review of Legislation, 1907–8. Legislation 391, p. 119–22 (Issued Sept. 1910)

A review of legislation for the years 1907 and 1908.

The Leopard Moth. Country Gentleman, Sept. 29, 1910, 75:922[21]

This insect, Zeuzera pyrina Fabr. and its work is described and control measures summarized.

ADDITIONS TO COLLECTIONS, OCT. 16, 1909--OCT. 15, 1910

The following is a list of the more important additions to the collections:

DONATION

Hymenoptera

Thalessa atrata Fabr., black long sting, adult on maple, June 13, S. W. Stillwell, Charlotteville

T. lunator Fabr., lunate long sting, adult, July 23, A. L. Kampfer, Albany

Aulacidea tumidus Bass., gall on Lactuca, August 30, Roy Latham, Orient Point

Neuroterus batatus Fitch, galls on white oak, July 8, J. H. Dodge, Rochester. Through State Department of Agriculture

Lophyrus abbotii Leach, Abbott's sawfly, larvae on pine, August 3, Andrew Lackey, Johnsburg. Same, from J. W. Wilson, Olmstedville

L. ? lecontei Fitch, Leconte's pine sawfly, larvae on pine, October 20, Townsend Cox, jr, Setauket

Trichiocampus viminalis Fall., poplar sawfly on poplar, August 29, H. S. Post, Albany

Eriocampoides limacina Retz., cherry and pear slug, larvae on cherry, August 22, L. A. Rose, Rensselaer

Harpiphorus tarsatus Say, sawfly, larvae on Cornus mascula, September 15, J. H. Dodge, Rochester. Through State Department of Agriculture

H. versicolor Nort., sawfly, larvae on Cornus alternifolium, September 18, L. F. Rinkle, Boonville

Coleoptera

Entimus imperialis Forster, diamond beetle, adult, May 7, Richard Lohrmann, Herkimer

Calandra granaria Linn., granary weevil, adults in grain bins, December 27, P. A. Schaefer, Allentown, Pa.

Magdalis ? barbita Say, black elm snout beetle, grubs on elm, March 18, S. L. Frey, Palatine Bridge

Pissodes strobi Peck, white pine weevil, larvae on pine, July 13, Benjamin Dorrance, Dorranceton, Pa. Through Hermann Von Schrenk

Phloeodes diabolicus Lec., adult on Polyporus growing on Eucalyptus, March 20, Hermann Von Schrenk, Southern California

Bruchus obtectus Say, bean weevil, adults, March 21, F. A. Fitch, Randolph

Haltica ignita Ill., strawberry flea beetle, adults on Virginia creeper, August 3, Miss L. E. Clarke, Canandaigua

Galerucella luteola Müll., elm leaf beetle, larvae and pupae on elm, July 19, F. T. Clark, Ticonderoga

Melasoma scripta Fabr., cottonwood leaf beetle on poplar, September 7, Theodore Foulk, Flushing. Through State Department of Agriculture

Centrodera decolorata Harr., adults on locust, October 18, Mrs J. De P. Lynch, Barneveld

Desmocerus palliatus Forst., cloaked knotty horn, adults on elder, June 6, H. T. Brown, Rochester

Elaphidion villosum Fabr., maple and oak twig pruner, work on oak, July 31, W. A. Payne, Bronxville

Prionus laticollis Dru., broad-necked Prionus, adult, July 18, Burton Ellison, Poughkeepsie

Xyloryctes satyrus Fabr., rhinoceros beetle, August 1, D. T. Marshall, Hollis

Euphoria inda Linn., bumble flower beetle, adult, September 6, J. D. Keating, Fort Edward

Cotalpa lanigera Linn., goldsmith beetle, adult, April 15, J. R. Gillett, Kingston

Thanasimus rufipes Brahm, adult, July 29, L. H. Joutel, New York (European)

Podabrus rugosulus Lec., adults, June 16, H. B. Filer, Buffalo

Agriotes mancus Say, wheat wireworm, larvae on oats, May 20, Purley Minturn, Locke

Diptera

Calliphora viridescens Desv., larvae, July 30, Mrs H. G. Reist, Schenectady

Bombyliomyia abrupta Wied., adult, July 26, H. E. A. Dick, Rochester

Rhyphus fenestralis Scop., adults, April 24, G. C. Hodges, New Hartford

Bibio xanthopus Wied., adult, May 18, Richard Lohrmann, Herkimer

Contarinia johnsoni Sling., grape blossom midge, adult, May 28, Fred Johnson, North East, Pa.

Monarthropalpus buxi Lab., pupae on box, May 19, A. E. Stene, Kingston, R. I.

Joanissia aurantiaca Kieff., Aprionus miki Kieff., A. pinicola Kieff. MS., Monardia stirpium Kieff., Bryomyia bergrothi Kieff., Miastor cerasi Kieff. MS., Brachyneura squamigera Winn., Winnertzia fusca Kieff. MS., W. pinicola Kieff. MS., Colomyia clavata Kieff., Colpodia anomala Kieff., Dicerura scirpicola Kieff., Porricondyla venustus Winn., Camptomyia ? binotata Kieff., C. nigricornis Kieff., Holoneurus pilosus Kieff. M.S., Lasioptera rubi Heeg., Baldratia salicorniae Kieff., Stefaniella atriplicis Kieff., Trotteria sarothamni Kieff., Rhizomyia silvicola Kieff., Cystiphora taraxaci Kieff., Macrolabis stellariae Kieff., Arnoldia castanea Kieff. MS., A. sambuci Kieff., A. cerris Koll., Lasiopteryx (Ledomyia) divisa Kieff., L. (Ledomyia) lugens Kieff., Dasyneura sisymbrii Schrnk., D. urticae Perris, Rhabdophaga karschii Kieff., R. pierrei Kieff., Mikiola fagi Hart., Psectrosema tamaricis Stef., Schizomyia galiorum Kieff., Zeuxidiplosis giardiana Kieff., Stenodiplosis geniculati Reut., Thecodiplosis brachyntera Schw., Bremia longipes Kieff., B. ramosa Kieff., Aphidoletes urticariae Kieff., Massalongia rubra Kieff., Hormomyia cornifex Kieff., Monarthropalpus buxi Lab., Pseudhormomyia granifex Kieff., Xylodiplosis aestivalis Kieff., X. nigritarsis Zett., Putoniella marsupialis F. Lw., Endaphis perfidus Kieff., Macrodiplosis volvens Kieff., Clinodiplosis galliperda F. Lw. All from Prof. J. J. Kieffer, Bitsch, Germany, and especially valuable because a number are cotypes

Lepidoptera

Sphecodina abbotii Sm. & Abb., Abbott's sphinx, larva on woodbine, July 13, Mrs Carriere, Albany

Saturnia pavonia Linn., Emperor moth, cocoon on French nursery stock, January 31, Rochester. Through State Department of Agriculture

Anisota senatoria Sm. & Abb., larvae on oak, September 9, L. C. Griffith, Lynbrook. Through State Department of Agriculture

Basilona imperialis Dru., Imperial moth, larva on pine, August 18, Andrew Lackey, Johnsburg

Ctenucha virginica Charp., larvae on pine and gooseberry, L. H. Adams, Johnstown. Through State Department of Agriculture

Halisidota caryae Harr., hickory tussock moth, larvoe on maple, July 11, L. C. Griffith, Lynbrook. Through State Department of Agriculture

Arsilonche albovenosa Goeze, larva, September 27, William Hotaling, Kinderhook

Xylina antennata Walk., green fruit worm, larvae on maple, June 16, Alex Anderson, Stonyford. Same, larvae on apple, June 28, Geneva. Through State Department of Agriculture

Notolophus antiqua Linn., rusty tussock moth, eggs, March 9, H. W. Gordinier, Troy. Same, caterpillars on elm, June 18, H. E. Vaughan, Ogdensburg

Datana ? integerrima G. & R., larvae, July 11, L. C. Griffith, Lynbrook. Through State Department of Agriculture

Schizura concinna Sm. & Abb., red-humped apple caterpillar, larvae on apple, September 10, C. C. Perry, Eagle Bridge

Synchlora viridipallens Hulst, adult, August 4, Louis Capron, Menands

Cingilia catenaria Dru., chain-spotted geometer, larvae on sweet fern, bayberry, August 2, L. C. Griffith, Sag Harbor. Through State Department of Agriculture

Ennomos subsignarius Hübn., snow-white linden moth, eggs on maple, March 28, Edward Thomson, Frost Valley, Denning. Same, adult, July 22, J. C. Ayer, Glen Cove

Phobetron pithecium Sm. & Abb., hag moth caterpillar, larva, September 13, W. A. Bullis, West Sand Lake

Zeuzera pyrina Linn., leopard moth, pupae, July 1, H. I. Newell, Richmond Hill. Same, exuviae on maple, July 5, T. J. Beam, Port Chester. Through State Department of Agriculture. Same, larva on apple, September 17, E. G. Serins, South River, N. J. Through Country Gentleman

Hyponomeuta malinella Zell., ermine moth, larvae on imported French apple stock, June 24, J. H. Dodge, Rochester. Same, larvae on apple, June 27, J. J. Barden, Orleans

Ancylis nubeculana Clem., larvae on apple, September 1, R. H. Ham, Niverville

Dichomeris marginellus Fabr., Juniper webworm, larvae on Juniper, February 28, S. G. Harris, Tarrytown. Same, larvae on Irish Juniper, April 26, L. D. Rhind, Plandome. Through State Department of Agriculture

Aspidisca splendoriferella Clem., resplendent shield bearer, winter cases, March 24, Benjamin Hammond, Fishkill

Hemiptera

Belostoma americanum Leidy, giant waterbug or electric light bug, adult attached to a fish, May 4, J. D. Collins, Utica

Brochymena quadripustulata Fabr., adult, July 15, D. H. Cook, Altamont. Same, nymphs, August 26, W. P. Thorne, Lagrangeville

Blissus leucopterus Say, chinch bug, nymphs on corn, August 5, Fred Wheeler, Mongaup Valley. Through State Department of Agriculture

Haematopinus piliferus Burm., sucking dog louse, adult on dog, January 8, V. P. D. Lee, Altamont

Ormenis pruinosa Say, lightning leaf hopper on matrimony vine, August 26, Mrs C. F. Webber, Athens

Aleyrodes vaporariorum Westw., white fly on coleus, August 26, Mrs C. F. Webber, Athens

Chermes abietis Linn., spruce gall aphis, galls on spruce, June 23, F. F. Briggs, Pocantico Hills. Same, adults on spruce, June 26, S. G. Harris, Tarrytown. Same, galls on spruce, October 12, Theodore Foulk, Flushing

C. cooleyi Gill., galls on Colorado blue spruce, August 4, White Plains, State Department of Agriculture

C. pinicorticis Fitch, pine bark aphid, adults on pine, May 12, M. T. Richardson, New York city. Same, eggs, February 12, Miss Pauline Goldenmark, New York city

C. piceae Ratz., adults and eggs on Nordmann's fir, May 17, Rochester. Through State Department of Agriculture

C. pinifoliae Fitch, pine leaf aphid, adult on black spruce, January 29, Miss Edith M. Patch, Orono, Me.

C. consolidatus Patch, adults on larch, January 29, Miss Edith M. Patch, Orono, Me.

C. floccus Patch, adult on black spruce, January 29, Miss Edith M. Patch, Orono, Me.

C. lariciatus Patch, adults on white spruce, January 29, Miss Edith M. Patch, Orono, Me.

Pemphigus imbricator Fitch, beech blight, nymph on beech, August 31, G. C. Wood, Barneveld

P. tessellata Fitch, woolly maple leaf aphid, adults on maple, June 16, A. P. Knapp, Hillsdale, N. J. Through Country Gentleman. Same, eggs, June 20, Miss May Seymour, Lake Placid

Schizoneura americana Riley, woolly elm leaf aphid, adults on elm, June 5, R. M. Boren, Ballston Lake. Same, adults and young on elm, June 10, W. P. Judson, Broadalbin. Same, adults on elm, June 18, H. E. Vaughan, Ogdensburg

S. lanigera Hausm., woolly apple aphis, nymph on apple, November 9, C. S. Ashley, Old Chatham. Same, Mrs S. H. Niles, Coeymans. Same, November 10, J. F. Rose, South Byron. Same, November 13, Bell & Smith, Castleton. Same, C. C. Woolworth, Castleton

Lachnus abietis Fitch, on balsam, September 8, C. H. Peck, Lake Placid

Psylla pyricola Forst., pear psylla, adults on pear, September 20, John Dunbar, Rochester

Pachypsylla celtidis-gemma Riley, hackberry nodule gall, galls on hackberry, February 16, H. B. Smith, Nashville, Tenn. Through Garden Magazine, Doubleday, Page & Co.

Eulecanium tulipiferae Cook, tulip tree scale on tulip, August 31, O. W. Peterson, Fairfield county, Conn. Through Country Gentleman

Asterolecanium pustulans Ckll., golden oak scale, adults on oak, May 16. Through State Department of Agriculture

A. variolosum Ratz., on oak, September 7, Theodore Foulk, Flushing. Through State Department of Agriculture

Phenacoccus acericola King, false cottony maple scale, young, January 21, Archibald Beresford, Mt Vernon. Same, eggs on maple, July 18, Mrs Alice G. Fisher, Batavia. Same, females and young on maple, October 4, Miss Fanny G. Dudley, Newburgh

Pseudococcus longispinus Targ., mealy bug, February 24, C. E. Olsen, Winfield. Same, larvae on coleus, August 30, Albany. Through Country Gentleman

Pulvinaria vitis Linn., cottony maple scale, females and young on maple, July 26, G. W. Morley, Haverstraw. Through State Department of Agriculture

P. occidentalis subalpina Ckll., immature, August 31, T. D. A. Cockerell, Boulder, Col.

Gossyparia spuria Mod., elm bark louse on elm, July 9, R. H. C. Bard, Syracuse. Through State Department of Agriculture

Eriococcus azaliae Comst., on azalea, November, Brooklyn. Through State Department of Agriculture

Aulacaspis pentagona Targ., West Indian peach scale, adult on imported Japanese flowering cherry, January, P. L. Huested, Kingston. Same, adult on Japanese cherries, February 3. Through State Department of Agriculture

A. rosae Bouché, rose scale on rose, November 13, C. C. Woolworth, Castleton. Same, adults on rose, April 29, L. L. Woodford, Pompey

Chionaspis americana John., elm scurfy scale, crawling young, May 10, W. B. Landreth, Schenectady

C. euonymi Comst., euonymus scale, eggs on ? Euonymus, May 19, C. H. Hechler, Roslyn

Fiorinia fioriniae var. japonica Kuw., adults on Japanese hemlock, June 9, Long Island. Through State Department of Agriculture

Orthoptera

Chortophaga viridifasciata DeG., green-striped grasshopper, nymphs, March 26, N. Ashley, Old Chatham

EXCHANGE

Galls received from Prof. Mario Bezzi, Torino, Italy

Cystiphora sonchi F. Lw. on Sonchus arvensis L., Sondrio, Italy

Dryomyia circinans Gir. on Quercus cerris L., Mantua, Italy

Dryomyia lichtensteinii F. Lw. on Quercus ilex, Macerata, Italy

Dasyneura sisymbrii Shrnk. on Nasturtium silvestris L., Milan, Italy

[1] Perrisia sp. on Cucubalus bacerifer (?) L., Bergamo, Italy

Perrisia sp. on Polygonum bistorta L., Sondrio, Italy

Perrisia alpina F. Lw. on Silene acaulis L., Sondrio, Italy

Perrisia capitigena Br. on Euphorbia cyparissias L., Macerata, Italy

Perrisia crataegi Winn. on Crataegus oxyacantha L., Milan, Italy

Perrisia ericina F. Lw. on Erica carnea L., Como, Italy

Perrisia fraxini Kieff. on Fraxinus excelsior L., Sondrio, Italy

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[1] A synonym of Dasyneura.

Perrisia oenophila Haimh. on Vitis vinifera L., Sondrio, Italy
Perrisia pustulans Rubs. on Spiraea ulmaria L., Sondrio, Italy
Perrisia rosarum Hdy. on Rosa canina L., Sondrio, Italy
Perrisia salicariae Kieff. on Lythrum salicaria L., Milan, Italy
Perrisia ulmariae Br. on Spiraea ulmaria L., Sondrio, Italy
Rhabdophaga rosaria H. Lw. on Salix purpurea L., Sondrio, Italy
Mikiola fagi Hart. on Fagus silvatica L., Bergamo, Italy
Rhopalomyia artemisiae Bouché on Artemisia campestris L., Sondrio, Italy
Oligotrophus sp. on Juniperus communis L., Mallare, Italy
Oligotrophus capreae Winn. on Salix caprea L., Sondrio, Italy
Oligotrophus corni Gir. on Cornus sanguinea L., Relegon, Como, Italy
Oligotrophus reaumurianus F. Lw. on Tilia parviflora Clerk., Sondrio, Italy
Oligotrophus solmsii Kieff. on Viburnum lantana L., Sondrio, Italy
Oligotrophus taxi Inchb. on Taxus baccata L., Mallare, Italy
Mayetiola poae Bosc. on Poa nemoralis L., Sondrio, Italy
Asphondylia sp. on Scrophularia canina L., Selvius, Bergamo, Italy
Asphondylia sarothamni H. Lw. on Sarothamnus scoparius Link., Sondrio, Italy
Schizomyia pimpinellae F. Lw. on Pimpinella magnus L., Como, Italy
Harmandia petioli Kieff. on Populus tremula L., Sondrio, Italy
Harmandia tremulae Winn. on Populus tremula L., Sondrio, Italy
Clinodiplosis vaccinii Kieff. on Vaccinium uliginosum L., ? Valmaleneo, Sondrio, Italy

APPENDIX

MIASTOR AMERICANA FELT

An account of pedogenesis

The remarkable larvae of Miastor, presumably M. americana Felt, were found Oct. 5, 1910 under the partially decayed inner bark and in the sapwood of a chestnut rail used to fence a shady roadside in the vicinity of Highland. Additional material was secured October 19th, and from these two lots we have been fortunate in being able to follow through the larval life cycle and to actually witness pedogenesis, now regarded as a modification of parthenogenesis. These minute larvae are very easily handled and studied and should therefore be extremely serviceable to teachers of zoology and biology desiring to give their classes first-hand information respecting this phase of reproduction. Our studies of this form are given below in some detail in the hope that many teachers will find it advantageous to make use of these larvae in their class work.

Habitat. The moist inner bark of various trees showing incipient decay is the most likely place to find Miastor larvae. Those discussed in these pages were discovered in the fall, working in the partially decayed chestnut bark of a rail fence along a shaded roadside. The larvae were most abundant in the soft, partly decayed bast just beyond the point invaded by various borers in dead wood and the accompanying predaceous Dipterous larvae. An allied, though undetermined, species was taken under similar bark of a chestnut stump in a wood lot. European observers report the occurrence of these and allied larvae under the bark of a variety of trees, such as beech, birch, poplar, oak, elm, ash and ironwood, and even in sugar beet residue.

Recognition characters. It is very probable that these larvae have been repeatedly overlooked by collectors, simply because when occurring singly or in small colonies they present no very striking characteristics. Large colonies of this remarkable form are easily recognized by the masses of more or less adherent yellowish or whitish larvae, and especially by the presence here and there of larger, motionless individuals, some of which usually contain young so well developed as to be easily seen with a hand magnifier. A careful examination with a pocket lens will show, even in the case of isolated larvae, a distinct head and a fuscous ocular spot in the sedgment just behind. The head is flattened, triangular, with a pair

of diverging antennae and quite different from the strongly convex, usually fuscous head of Sciara larvae sometimes occurring in similar situations. Predaceous larvae likely to be associated with Miastor, may be instantly recognized by the body tapering to the small anterior segments, and especially by the chitinized, usually fuscous, hooked mouth-parts. Small Dipterous maggots having a length of one-twentieth to one-eighth of an inch and occurring under conditions described above, should be carefully examined if one is searching for this or allied species.

Value to zoologists and biologists. Miastor larvae and their allies should be of great service to teachers of zoology and biology, since they admit of the study at first-hand of one form of parthenogenesis. It is possible with a no more elaborate outfit than an ordinary student's microscope equipped with a three-quarter objective, a microscopic slide and a few cover glasses, to observe the vital activities of the young larva, to see the muscular, respiratory, digestive and nervous systems, to identify the ovaries and to watch the gradual development of the semitransparent embryos within the mother larva. Furthermore, this larva is well adapted to more exact histological methods, being soft and therefore an excellent subject for serial sections and stains, particularly as it is comparatively easy to secure from one colony a series of individuals representing different stages of development.

There are other considerations aside from the interest attaching to their morphology and biology which should appeal strongly to the teacher of zoology. These larvae are widely distributed and, with an understanding of their habits, there should be little difficulty in finding them. Moreover, they are small, and a piece of wood six inches long, three inches wide and half an inch thick may contain or produce material enough for a fair sized section or class in zoology. The larvae are prolific and under favorable conditions would probably multiply at any season of the year. This is certainly true of the fall, the early winter and the spring. They are so amenable to artificial conditions as to make it possible to keep them alive for at least a month in microscopic cells, and with care a larval generation will develop in such restricted quarters. We have kept larvae healthy and multiplying for more than three months with nothing more elaborate than a moist piece of decaying wood clamped lightly to an ordinary microscopic slide. These remarkable larvae are very hardy. Prolonged dryness simply results in a suspension of activities, while they are quite resistant to an

abundance of moisture. We have kept them alive in sealed water-filled cells without food for five weeks. With our present knowledge we see no reason why artificial colonies might not be established in the vicinity of a zoological laboratory and maintained with very little or no attention from year to year, if not for a decade or more.

Description. The parents of these remarkable larvae are small midges belonging to the Dipterous family Itonidae, better known as the Cecidomyiidae or gall midges. The members of this family are all small Diptera with the tibiae unarmed apically, the coxae not produced and the wings usually with but three or four long veins and no cross veins. Extreme forms may have six or seven long veins and one cross vein or, as a result of reduction, the veins may have nearly disappeared.

The subfamily Heteropezinae, to which Miastor and its allies belong, comprises a number of exceedingly peculiar forms, some of them most remarkable on account of the great degree of specialization by reduction — physiological as well as morphological. Members of this subfamily may be separated from the Itonidinae by the absence of circumfili, and from the Lestremiinae by the great reduction in the venation, there being at most, three long veins. The metatarsus may be longer than the following segment, while the number of tarsal segments may be reduced to two. Certain species have quinquearticulate tarsi and the wing membrane thickly clothed with rather broad, striate scales. The production of larvae by larvae or pedogenesis is known to be true of several genera referable to this subfamily, the larvae of which appear to live for the most part in decaying vegetable matter and are therefore likely to be found in searching for Miastor larvae. The adults of Miastor appear in June, while the one known American species of Oligarces was taken in July. The following table will facilitate the recognition of the genera in this group.

KEY TO GENERA

a Metatarsus longer than the second segment
  b Tarsi quadriarticulate; 3 long veins; palpi biarticulate — Miastor Mein.
  bb Tarsi triarticulate; 2 long veins; antennal segments cylindric — Heteropeza Winn.

aa Metatarsus shorter than the second segment
  b Tarsi quinquearticulate
    c Wing membrane finely haired
      d 3d vein extending to the apex of the wing
        e Palpi quadriarticulate
          f 5th vein forked — Haplusia Karsch
          ff 5th vein simple — Johnsonomyia Felt

ee Palpi triarticulate — Meinertomyia Felt
dd 3d vein not extending to the apex of the wing
eee Palpi uniarticulate — Leptosyna Kieff.
e Palpi biarticulate — Frirenia Kieff.
ee Palpi triarticulate — Epimyia Felt
cc Wing membrane scaled; 3 simple veins; palpi triarticulate — Brachyneura Rond.
bb Tarsi biarticulate — Oligarces Mein.

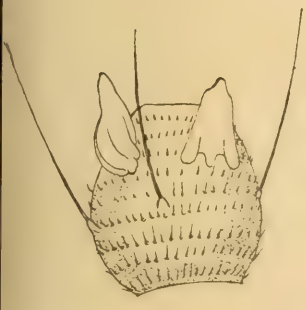

Fig. 7 Fifth antennal segment of Miastor americana, greatly enlarged. (Original)

Fig. 10 Side view of thorax, legs and abdomen of Miastor americana. (Original)

Fig. 8 Palpus of Miastor americana, greatly enlarged. (Original)

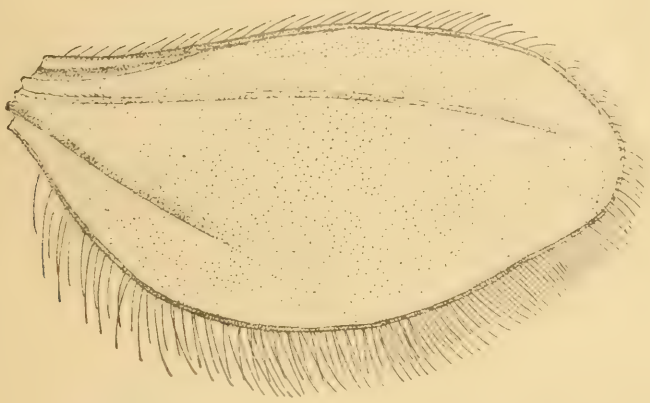

Fig. 9 Wing of Miastor americana, greatly enlarged. (Original)

M. americana. *Female.* Length 2.5 mm., slender. Antennae extending to the base of the coxae, sparsely haired, brown; 11 segments, the first short, stout, irregularly subglobose, the second ½ longer, the fifth subcylindric, with a length about ¼ greater than its diameter, tapering at both extremities, subsessile; a very sparse subbasal whorl of stout setae; subapically and apparently on the ventral surface, a pair of large, irregularly subconic, semitransparent processes (fig. 7); the distal segment subglobose, broadly rounded apically. Palpi biarticulate, the first segment irregularly oval, the second ½ longer, broadly oval, both sparsely setose. Mesonotum

dark brown. Scutellum reddish brown, postscutellum fuscous yellowish. Abdomen pale salmon, fuscous basally, yellowish apically. Wings hyaline, costa pale yellowish, subcosta uniting with the margin at the basal third, the third vein, curving distally, just before the apex, the fifth simple and disappearing just before the basal half; fringe long, slender. Legs a nearly uniform yellowish brown, the tarsi quadriarticulate, the first segment short, about ½ longer than the second, which latter is distinctly longer than the third, the fourth a little longer and stouter than the second; claws long, slender, simple, the pulvilli nearly as long as the claws. Ovipositor short, the lobes long, slender, triarticulate, the basal segment stout, subtriangular, the second longer, subrectangular, the third narrowly oval, all sparsely setose; on the venter of the seventh abdominal segment there is a submedian pair of obpyriform, chitinous appendages, possibly orifices of odoriferous glands.

Larva (presumably M. americana). Length 1.25 to 4 mm. Young larvae yellowish or whitish transparent, the larger larvae whitish or reddish orange. The large, white larva is rather stout, tapering somewhat at both extremities and frequently nearly filled with white adipose tissue. There are 13 body segments. The head (pl. 26, fig. 2) is small, triangular and frequently retracted within the body segments. The palpi are short, stout, biarticulate and arising from the anterior portion of the head, the tip of the head usually fuscous. The irregularly bilobed ocular spot is usually seen as a fuscous mass in the third segment. The posterior extremity tapers to an obtuse apex bearing a series of 6 stout, frequently recurved, cuticular processes. The body segments are banded ventrally (pl. 29, fig. 2) with closely set series of short, stout spines pointing backward, these spines being most strongly developed upon the anterior body segments, especially the third, fourth and fifth (pl. 22).

The quiescent larva, easily recognized by its somewhat stiff attitude, due probably to the relaxation of the transverse muscles girdling each segment, may be whitish and contain semitransparent embryos, easily seen by reflected light (pl. 23, fig. 1) or yellowish and filled with nearly mature embryos (pl. 24, fig. 1).

The young larvae are 1.2 to 2 mm. long and present all the characters described above for the larger white larvae except that they are yellowish or yellowish transparent, usually more slender and appear to have a relatively much better developed musculature.

Musculature. The muscles are especially well developed in the young larvae. They consist of a series of longitudinal and oblique muscles extending from the anterior to the posterior margins of the body segments. There are a number of transverse, girdling muscular bands, which are particularly well developed at the union of the body segments, though several distinct broad bands may be observed near the middle of each segment.

Respiratory system. The tracheal trunks comprise a double series on each side extending nearly the entire length of the body and sending minute branches to lateral spiracles on the fourth to the eleventh body segments. The dorsal trunks are united to each other by transverse tracheae in the posterior third of body segments five to eleven inclusive and, in addition, send minute branches to the various organs of the body. The tracheal system of a living, semitransparent larva may be easily examined in a water mount.

Nervous system. This is composed of the pyriform submedian optic lobes and the fuscous, lobulate, socalled ocular spot, the bilobed brain in the fourth and fifth body segments and a series of ganglia united by submedian nerves as follows: A broadly oval ganglion occupying the length of the third body segment and with a width fully equal to half its diameter; a shorter, more slender ganglion in the anterior portion of the fourth segment; a broadly pyriform ganglion in the anterior third of the fifth body segment. Separated slightly therefrom, another ganglion lies in the posterior portion of the fifth and the anterior part of the sixth body segments. It is a little narrower than the preceding though it has an equal length. The fifth and sixth ganglia, each short, subquadrate, occur in the sixth body segment; the seventh ganglion is one-half longer than the sixth and is situated in the middle of the seventh body segment; the eighth to the twelfth body segments each appear to have one ganglion, the posterior one almost extending to the anterior margin of the thirteenth body segment.

Digestive system. The digestive system, difficult to study because of its being largely inclosed by nearly opaque adipose tissue, consists, according to Kahle, of a comparatively simple tube extending the entire length of the body, the granular salivary glands occurring in the fifth to the ninth body segments, while the long, slender, malpighian tubes may be found in the 11th to 13th segments, inclusive.

History of pedogenesis. The discovery of this remarkable phenomenon is credited to Nicolas Wagner, professor of zoology at Kasan. He published a short note in the *Journal of the University of Kasan* in 1861 or 1862, and in 1865 a detailed account. The latter was held by the editor for almost two years because of its "almost incredible" character. The observations of Wagner were confirmed by Meinert and Pagenstecher in 1864, and by Hanin, Leuckart and Mecznikoff in 1865. Wagner believed at first that the embryos originated in the adipose tissue, at the expense of which they develop very largely. Later he, Leuckart and Mecznikoff satisfied themselves that the embryos originated from ovaries.

The investigations of these scientists covered approximately a decade, 1862 to 1872, which was followed by a long period of apparent lack of interest in these larvae, very little original being published from the latter date until the exhaustive studies in 1908 by Kahle, who employed modern laboratory methods, demonstrated the general correctness of the earlier observations and satisfied himself that the process was a true parthenogenesis. It does not seem to have occurred to any one that these larvae might be of great service to the teacher of biology.

This method of reproduction has been observed by Meinert in Miastor, Oligarces and Meinertomyia (Pero Mein.) and by Kieffer in Leptosyna. The latter believes the same to be true of Frirenia, though he has not observed mother larvae, since the females contain the unusually large eggs characteristic of genera reproducing in this manner.

Pedogenesis or close approach thereto is known to occur in the Chironomidae. Grimm in 1870 describes a larval Chironomus in which eggs develop, they escaping, however, from paired submedian ventral orifices in the eighth abdominal segment of the pupa. This must be construed as at least a modification of the process exhibited by Miastor and its allies. Professor Johannsen recorded in 1910 a pedogenetic larva, T a n y t a r s u s d i s s i m i l i s Jhns., which had come under his observation and that of the late Dr James Fletcher, though no data has been published to show the exact character of this process. Professor Johannsen also refers to an account of pedogenesis in this genus observed in Bohemia by Professor Zavrel.

Habits. These larvae appear to thrive only in the moist, partly rotten inner bark and punky sapwood which has not been invaded to any considerable extent by other Dipterous larvae or Coleopterous borers. They exhibit a manifest tendency to occur in segregated masses, frequently between loose flakes of bark or in rather broad crevices. These colonies contain in autumn old empty skins of mother larvae; a number of yellowish mother larvae with approximately five to fifteen young within; very numerous, small, yellowish larvae showing no trace of embryos; a number of white, various sized active larvae, frequently white, sometimes semitransparent; and a few quiescent white larvae containing young embryos. Such larval colonies are most likely to be found in somewhat flaky inner bark, especially where conditions allow several larvae to lie side by side (pl. 26, fig. 1).

Slender, yellowish larvae are often found lying between wood fibers, in some instances apparently having penetrated several inches from the nearest adjacent larvae. These latter do not appear to grow so rapidly as is the case in the more populous colonies, and they also seem to be less prolific, since the few larvae we have observed under such conditions, produced only three or four, and mostly but one, young. The small, yellowish larvae lying in crevices, mentioned above, frequently occur in series, sometimes one or two lying side by side. They move comparatively little, action being confined largely to the head and the semitransparent anterior body segments. Such larvae appear to remain almost unchanged for two weeks or more. These muscular larvae, with their bands of retrose spines especially well developed on the anterior body segments, are admirably adapted for forcing their way between partially rotten tissues, a procedure which is also of material service in giving them relative immunity from attack by natural enemies. The small yellow larvae were most abundant in our material during the winter months.

Active larvae crawl rapidly over moist wood and glass, and have even been observed wriggling between colonies of mold. Lack of moisture appears to cause a partial suspension of vital activities, while flooding does not seem to be very injurious. The mouthparts of the larvae, though the anterior portion of the head is strongly chitinized, appear to be comparatively weak, and, while we have repeatedly observed these larvae moving the head about and examining adjacent tissues, we have seen no indication of gnawing or boring. The alimentary canal contains little that can be discerned with the aid of a compound misroscope, and we are inclined to believe that a considerable portion of their nourishment is absorbed by osmosis after escaping from the mother larva, as well as before. It would appear as though the several types of larvae occurring in a colony are possibly only modifications, due to the relative amount of nourishment obtained by the individual.

Normally, reproduction by pedogenesis occurs throughout the warm months of the year and even into late fall, and commences in early spring, the cold weather of winter simply causing a suspension of activities. Dr Kahle, after an extended series of observations, was led to believe that asexual multiplication might continue uninterruptedly for possibly a period of two or three years. This appears reasonable, since somewhat recent experiments by Slingerland have shown that a plant louse might produce nearly 100 asexual

generations in almost four years and presumably was capable of continuing this much longer. The adults of Miastor and Oligarces occur in midsummer, a season when the midges of most of these forms are probably abroad.

Biological observations. The first larvae secured were taken October 5, 1910, placed in an ordinary fruit jar with moist sand and subsequently allowed to become rather dry. A second lot was obtained October 19 and on examining the latter November 18th, an adherent mass of young larvae evidently recently escaped from the mother larva was found. Soft, partially rotten wood was taken from the earlier lot presumed to contain little or nothing alive, and one or two of these young larvae placed in a groove in each piece of wood, the latter being attached by light clamps, either directly to a microscopic slide or held between a pair. These preparations were kept in a closed tin box on damp blotting paper. It was hoped that we would be able to watch the development of the one or more larvae thus placed in each piece of wood. Most of these for some reason or other escaped and we soon found that the additional moisture given these pieces resulted in renewed activities on the part of many larvae concealed in the woody tissues. On November 28, ten days after these preparations had been made, numerous young larvae were observed in most of the preparations, the majority probably recent young of larvae stirred to renewed activity by the addition of moisture. Throughout November and in early December large, white mother larvae capable of producing from five to perhaps fifteen embryos were frequently seen. The latter part of December and during January large, white larvae were difficult to find and the major portion of the reproduction was by the small, yellow mother larvae usually occurring in crevices in the sapwood and producing only one or two young. These preparations afford an excellent opportunity for determining the duration of the quiescent period under nearly natural conditions. This was found, as a result of observations upon a number of larvae, to be in the vicinity of a week, the movements of the embryo with the fuscous ocular spot and brown anterior portion of the head being observable about five days prior to the escape of the young. The occurrence of a small amount of mold did not seem to have a material effect upon the health of the larvae, and the same was true respecting the presence of mites, Tyroglyphus, which were upon occasions rather abundant in some of the preparations. The larvae crawl readily between the glass and the wood, occasionally

making their way to the margin of the preparation and sometimes escaping. A few were found lying upon the damp blotters in the bottom of the box, others between the blotters and more under the lower blotter on the tin bottom of the box. The larvae are evidently able to remain active for considerable periods without nourishment and with comparatively little oxygen, since it was observed that flooding of the preparation, even though continued for two or three days, apparently had no ill effect upon the larvae — subsequently we found that larvae would live submerged several weeks and the embryos develop.

The above was continued by isolating one or more larvae on ordinary microscopic slides. Each of these contained several small slivers of wood approximately .2 mm. thick and 1 to 1.5 em. long. These were laid upon the slide, moistened, several larvae added and a square cover glass placed over the whole, the margins being more or less perfectly sealed with vaseline. These preparations were designed primarily to secure more accurate data as to the length of the quiescent period, to facilitate observation upon the development of the embryo and also to ascertain the feasibility of rearing the larvae under such conditions. It was soon noted that while the vital processes were not at once inhibited by submersion, they were greatly retarded and if flooding was long continued, the embryos were unable to escape from the mother larva, though apparently well developed.

One moderate sized, apparently quiescent larva with finely granular contents and a brownish discoloration on one side was placed in such a cell December 12, 1910, together with a moderate sized, yellowish or yellowish white larva and a number of smaller ones. The 16th it was evident that the adipose tissue of this large larva was disintegrating, the several embryos being about one-half the length of the mother larva. On the 22d the embryo was apparently about three-fourths the length of the mother larva and there were no signs of either head or ocular spot. The next day the developing ocular spot was seen as a pair of narrowly oval, fuscous, submedian bodies, while most of the posterior part of the larva was filled with large, cuboidal cells arranged in a series of columns. The embryo at this time extended from the fifth to the thirteenth body segments of the mother larva. The following day the ocular spot was more evident and the apex of the head discernible. The 27th we were able to recognize two embryos, both with the large cells as described above. The 30th there was a distinct bulging

of the mother larva in the region of the fifth body segment, a condition presaging the nearly developed embryo. The next day the ocular spot was black. Observations were continued daily from January 1st to the 13th, during which time development appeared to be slow and a clear definition of the changes undergone almost impossible because of the condition of the cell. January 16th the embryos had escaped.

The moderate sized, yellowish or whitish larva mentioned above was lost sight of for a time, not being located till December 23, 1910, at which time it was found well established on the underside of a splinter of wood and with a length of about 3 mm. It remained moderately active for a time, two embryos being observed the 26th, at which time its color approximated closely that of the wood and accounted in large measure for its being overlooked earlier. The 28th the adipose tissue of the mother larva had nearly disappeared and on the 31st an ocular spot was visible in the young. January 1st the head and ocular spot of two embryos were recognized, and on the 5th embryonic movements were observed. The next day one embryo had extruded its head through the skin of the mother larva. Our records show that embryos remained within this mother larva till the 20th, possibly one or more perishing.

There were at least three small, yellowish larvae placed in this preparation with the two larger ones discussed above. These remained active for some days, two being located as quiescent, each containing an embryo about half the length of the mother larva, December 23, 1910, and from this on were subjected to daily observation. The first of these showed a grouping of the cells in rows the 24th, which became more distinct the next day, and on the 26th a median tract of darker cells was observable. The 28th the embryo extended from the second to the eleventh body segments of the mother larva and showed rather distinct masses of adipose and mesodermal tissue (pl. 35, fig. 3). The ocular spot was evident and the head slightly fuscous. On the 30th movements of the anterior extremity of the embryo and streaming of the body contents were observed, the mesodermal tissue was less conspicuous and the adipose tissue occupied more space. The embryo escaped from the mother larva January 1st. This was unusually early and may have been hastened by artificial causes.

The second small, yellowish, quiescent larva was located December 23, 1910 at which time it contained a large-celled embryo with a length fully one-half that of the mother larva. Three days

later the embryo extended from the fifth to the thirteenth segments of the mother lavra, the cells being arranged in indistinct rows and larger at the extremities. Owing to its position, it was impossible to properly illuminate this mother larva. The ocular spot and fuscous head were observed on the 30th and an active, well-developed larva seen January 2d, which remained within the skin of the mother larva till the 12th, an unusually long period, due possibly to the mother larva being partially surrounded by vaseline and therefore deprived of a proper supply of oxygen.

Three months after the establishment of the cell containing the larvae discussed above, their progeny were living under substantially the same conditions and gave every indication of producing young in due time.

A large, white, active larva was isolated under another slide December 12, 1910 with the conditions practically as outlined above. Six days later this larva had worked itself to the margin and become practically inclosed in a vaseline, water-filled cell where it remained for over a month, namely till January 20th. The development was unusually slow, probably due in large measure to the deficient supply of oxygen. Young, oval embryos were observed in the region of the sixth and seventh body segments December 19. On the 24th several embryos were found on the venter in the region of the tenth or eleventh segments, each with a length nearly equal that of the body diameter. There was a gradual increase in length and on the 26th one extended from the eleventh to the fourteenth segments of the mother larva. The adipose tissue was yellowish and reticulate by the 29th, though no signs of ocular spot or mouth parts were to be seen. January 2d a slight row of cells was visible in one embryo, this median streak becoming more apparent on the 5th. Extended masses of large, cuboidal cells were observed on the 7th, the ocular spot showing as a pair of minute, brownish spots. On the 16th well formed, embryonic heads and brown ocular spots were visible. This appeared to be about as far as development could go without additional oxygen, and though the vaseline cell was ruptured on the 20th no larvae escaped. The record is interesting since it gives an idea of the vitality of these larvae under adverse conditions.

Another quiescent, white larva containing at least two embryos was isolated December 12, 1910. The adipose tissue was granular and irregular. On the 16th the larva was nearly filled with whitish transparent embryos, the latter with a distinct median

streak. Five days later one embryo had a length equal to one-half that of the mother larva, the embryonic adipose and mesodermal tissue were rather distinct, while the adipose tissue of the mother larva was largely absorbed. On the 22d the form of the mother larva was distinctly modified by the obliquely-lying young, each with a length approximately three-fourths that of the parent. The next day we observed the mesoderm, composed of irregularly arranged, subhexagonal cells, accompanied by the appearance of incipient ocular spots in various embryos. The tip of the head became fuscous by the 28th and on January 5th, slight movements of the embryos were observed. Owing to the reduced oxygen supply, due to the larva being in a practically sealed cell, the embryos experienced difficulty in escaping. One was observed January 9th with the seven anterior segments protruding from the posterior extremity of the mother larva, remaining in the same position and nearly motionless the three following days. The cell was opened January 14th and the mother larva given air, but the action was apparently too late, as the young failed to revive. There appears to be sufficient oxygen in the tissue of the mother larva to permit the embryos to become fully developed.

Methods. The material taken in October was kept in ordinary fruit jars for a time, some of these at least being allowed to become rather dried. There was very little or no multiplication. On November 18th small pieces or slivers of somewhat dried wood containing these larvae were either clamped directly to ordinary microscopic slides or laid between two held together by means of light wire clips. These portions of infested wood were kept on moistened blotting paper in a dark, tin box, being examined every two or three days. Large, white mother larvae were produced from time to time and occasionally considerable colonies of small young were observed in the vicinity of the empty skins of mother larvae. Such preparations enabled us to keep track, not only of a colony but, by noting the location of quiescent larvae, even of individuals. Later this series was supplemented by a few fragments of wood laid upon microscopic slides, covered with large, square cover glasses and the margins more or less perfectly sealed with vaseline. The cell thus formed was kept moist and sometimes flooded with water. Under such conditions full grown white larvae, quiescent larvae and small, white or yellowish larvae were also studied. They apparently thrived for one week at least. Finally we selected a series of small, yellowish, active and quiescent larvae, placed them in water cells

nd observed the embryos and their various stages of develop-ient, photomicrographs being successfully made from this living aterial.

The observations on the small lots of material noted above were hecked by examinations of the fruit jars containing larger amounts f material. The latter jars were especially useful because the very umerous maggots made it possible to select at one time practically ll stages, which were mounted in considerable abundance. Some f the larvae were cleared with potassium hydrate and then stained ith Fuchsin, Hematoxylin, Eosin and Eosin-Hematoxylin. The ctions of the stains were all somewhat unsatisfactory and the ajority of our most successful mounts were entire larvae in rdinary balsam preparations which had been thoroughly cleared. he study of the mounts was checked by examination of living aterial as detailed above.

Embryology. The development of the embryo may be observed n the living larva. It is easily seen in the larger, white individuals ommon in the fall and producing a number of young, though the changes in the embryo are best observed in the small, yellow lar-vae, especially if they are mounted in shallow water cells.[1]

The region of the ovaries is marked in the large, white larvae by an irregular, yellowish green streak in the tenth or eleventh seg-ments. A close examination of such a larva may disclose the oval, large-celled ovaries nearly concealed by the submedian masses of opaque, white adipose tissue, especially if the larva rolls slightly. These organs are more easily detected in the young yellowish larva. They are submedian, whitish transparent, contrast rather strongly with the darker, more refractive adipose tissue and are located in the posterior portion of the tenth or the anterior part of the eleventh segment, one frequently being somewhat in advance of the other. They are composed of globular or oval, nucleated cells.

The youngest embryos we have observed are oval, granular and may be found in the large, white larvae in the vicinity of the ovaries. The motion of the internal organs appears to distribute the embryos through the body, there being from one to as many as seventeen in individual mother larvae. The young embryos are semitransparent and present a strong contrast to the opaque adi-pose tissue of the large, white larvae or the denser cells of the small, yellowish larvae. The youngest embryo photographed is

[1] We have used a ring of vaseline to support the cover glass and found such a cell very satisfactory as well as economical.

represented on plate 30, figures 2 and 3. It occurred in a small, yellow larva and had a length nearly equal to that of the ninth segment of the mother larva, its width being about one-fourth the diameter of the parent. This embryo is evidently in the morula stage, it being composed of a rather indistinct mass of irregular, closely placed cells, apparently with a slight infolding, the beginning of the blastoderm. At the posterior extremity there is a group of nucleated, large, polar cells. The next stage observed, though not photographed, was seen in larva Y. This embryo had a length equal to nearly twice the diameter of the mother larva. It was narrowly elliptical, with a length approximately three times its diameter and the polar cells, though visible, were not so evident as in the embryo described above. At its anterior extremity there was a slight thickening, apparently the much reduced cells of the corpus luteum. The median portion was occupied by a rather broad streak of dark, granular cells, bordered on either side and at the extremities by lighter, small-celled tissue. A more advanced stage is shown on plate 30, figure 1, and plate 31. This represents an embryo dissected from the large, white type of mother larva. It shows a distinct darker ectoderm and a lighter mesoderm, the anterior extremity having a conspicuous cap of large, dark cells. Portions of the posterior extremity and of the middle of the same embryo are represented still more enlarged on plate 31, figures 1 and 2. The time required for the small embryos to migrate from the region of the ovaries and develop to such an extent as described above and thus produce a quiescent stage in the large, white type of mother larva is approximately four to five days, much appearing to depend upon the size of the mother larva and the number of embryos present. The latter are perhaps most easily seen when viewed by reflected light (pl. 23 fig. 1, 2). The next stage in the development is illustrated on plate 32, figure 1. The embryo has a distinct cephalic cap of dark-celled tissue, a well defined germinal streak, the latter being broadly produced to one side in the region of the anterior third. The same general condition, though in a more advanced stage and apparently from a somewhat different viewpoint, is illustrated on plate 32, figure 4, and plate 33, figure 2, the dark ectoderm occupying one-third the width of the embryo and extending from approximately the region of the sixth to the twelfth segments; the cephalic cap persists as before. This condition appears to be followed shortly, though we have observed it somewhat clearly only in embryos developing in

the large, white mother larvae, by a great increase in the ectoderm, accompanied by its folding and extension anteriorly around the posterior extremity, the development of the large lobes anteriorly and its segregation into somatic masses, indistinctly shown on plate 27, figure 2, and apparently producing a peculiar cuboidal aspect illustrated on plate 28. The greatly developed mesoderm includes a series of large, cuboidal cells, some at least probably being the polar cells, and a certain portion destined to develop into a much more conspicuous mass to be described later. These changes are accompanied by a shrinking of the embryo from the extremities of the amniotic sac and the development of the digestive system by an invagination from both extremities. This latter is indicated in living embryos of young yellowish larvae, by the formation of irregular lobes at each extremity and the appearance in the region of the sixth to the twelfth segments, of a considerable mass of large-celled tissue, occupying most of that portion of the body cavity and which we believe to be mesoderm (pl. 35, fig. 2) and identical with that mentioned above. The changes from now on are rapid. This conspicuous mass of mesoderm gradually becomes absorbed or reorganized into organs such as the digestive system, its appendages and especially the ovaries, while the developing adipose tissue expands, occupies more space and produces a three-rowed appearance in the embryo (pl. 35, fig. 3). Development of the head now proceeds, the mouth parts become more definite, the ocular spot visible and the lobes at the posterior extremity become well defined. Motion may be observed in the embryo and shortly it is ready to escape from the mother larva. The length of the fully developed embryo is about 1 mm. It is frequently nearly as long as the small, yellow mother larva and approximately half as long as the large, white larva.

The development of the embryo reacts upon the mother larva and she soon assumes a rather characteristic quiescent form, undoubtedly an outcome of her lowered vitality due to the rapid absorption of nourishment by the young. This results in the relaxing of the muscles, especially the transverse girdling bands at the margins of the segments. The change in the condition of the mother is probably explainable solely upon physiological grounds. The time elapsing between the assumption of the quiescent stage by the mother larva and the escape of the young is about seven days. The first part of this period the embryos rarely exhibit signs of life, though distinct motions of the head and anterior segments

may be observed five days before they escape. The embryos are inclosed in the amniotic sac, which latter is ruptured before they escape from the body of the mother larva. There is a marked tendency among the embryos, when more than one occurs, to develop with their heads toward both extremities of the mother larva.

The growth of the embryo is correlated, as alluded to above, by interesting modifications in the mother larva. The large, well developed mother larva is easily recognized by her plump condition and the nearly solid, submedian masses of white adipose tissue filling the body from the fifth or sixth segment to the posterior extremity. Shortly after the escape of the embryos from the ovaries we observe clear patches (pl. 23, fig. 1), here and there in the mother larva, bordered by cells well filled with adipose tissue. Within a few days there is a striking modification and these large cells lose, probably by osmosis, a large proportion of the white, fatty matter and assume a somewhat reticulate character (pl. 23, fig. 2), which is soon followed by their disappearance, and the embryos absorbing practically all of the contents of the mother larva.

Records of individual embryos. The embryo in larva *A* was first detected January 17th. It then had a length about equal to two and one-half body segments of the mother larva. There was a distinct median streak of large, irregular cells, with a broad projection to one side near the anterior third, and a distinct cephalic cap of dark cells at the anterior extremity (pl. 32, fig. 1). The next day the germinal strip occupied an area approximately equal to one-third the width of the embryo (pl. 32, fig. 2), extending the following day to about half the width of the embryo, the clear space just behind the cephalic extremity being decidedly smaller. At this time the embryo had increased in length so that it extended from the posterior third of the fifth to the anterior fourth of the eighth body segment of the mother larva. There was some increase in length and minor changes in development from that date to the 27th, at which time there was a remarkable change, the germinal streak and its production to one side becoming narrower and being composed of unusually large cells; this change was soon followed by disintegration, the condition on the 28th being well illustrated on plate 32, figure 3.

The embryo of larva *B* was recognized January 17th, at which time it extended from the fourth body segment of the mother larva to the twelfth. The greater portion of the embryo consisted of a nearly uniform series of small, globular cells, though a darker area was visible on one side near the middle (pl. 34, fig. 1). Pulsa-

tions were visible in the body of the mother larva. The next day a series of moderately large, cuboidal cells were observed near the posterior extremity. This tissue became more distinct as development progressed, it becoming more evident by the 21st and occupying a still more prominent place the 23d and 24th. On this latter date two-thirds of the posterior portion of the embryonic body were filled with this tissue, somewhat as illustrated on plate 35, figure 2. The masses of adipose tissue on either side commenced to develop and eventually overspread and apparently absorbed in considerable measure the substances of the mesodermal tissue, a portion of which apparently develops into the ovaries. The embryonic digestive tract, apparently marked by large-celled tissue, appeared on the 27th to be nearly continuous throughout the entire length of the embryo. The embryo had shrunk a perceptible distance from the ends of the amniotic sac and the developing extremities were observed. The lobes of the antennae were recognized the following day as obtuse, buttonlike projections having a length less than three-fourths their diameter. Two days later the antennae had a length a little greater than their diameter; the ocular spots were indicated by indistinct, submedian, pigmented areas; the lobes of the brain could be traced; the salivary glands were submedian, narrowly lanceolate masses of large, glistening cells lying in presumably the sixth or seventh segments of the embryo, while the mesodermal tissue had retracted somewhat. The posterior extremity of the embryo was also well defined. February 1st there were three distinct rows of embryonic tissue, the two strips of adipose tissue and the large-celled mesoderm, the latter being less extensive the following day and largely obscured by adipose tissue on February 3d. There was a slow development from this time subsequently. On the 8th the ocular spots were light brown, diffuse, and the semitransparent mouth parts well developed, a fuscous appearance showing on the 9th. This embryo failed to escape from the mother larva.

The embryo in larva *C* extended from the third to the eleventh segments of the mother larva and had a distinct median streak January 17th. The latter on the 20th was seen to be composed of smaller, dark cells. The next day the embryo extended from the third to the middle of the twelfth segment of the mother larva. Development continued until the 27th, at which time it was nearly in the condition illustrated on plate 35, figure 2, the posterior portion being largely occupied by the mesodermal tissue. The an-

terior five or six segments of the embryo were semitransparent and the ocular spots represented by minute, brownish, submedian, pigmented areas. The next day the three-rowed condition, indicating the development of adipose tissue, was more apparent, while the lobed posterior extremity of the embryo was fairly definite. On the 30th developing salivary glands were distinguished near the anterior extremity of the adipose tissue. Free movements of the embryo were noted the 31st, and on February 1st it was seen that the head was well developed though semitransparent, the antennae having a length twice the diameter. The mesodermal tissue was obscured or absorbed to a considerable extent by the developing sublateral masses of adipose tissue. The head of the embryo was slightly infuscated on the 2d and the ocular spots purplish brown. Free movements of the embryo continued and on the 6th the mesoderm was largely concealed by adipose tissue. There was comparatively little development from this date onward, though the embryo continued active in the mother larva till the 10th. Owing probably to an insufficient supply of oxygen it was unable to escape.

One larva (*H*) separated January 17th, contained two embryos, each with a length about half that of the mother larva and both showing a distinct infolding near the middle of the germinal streak. The posterior extremities of these embryos showed several exceptionally large, compound cells — polar cells. Six were observed in the anterior embryo and apparently three in a row in the posterior embryo, the latter apparently moving anteriorly. Unfortunately this promising larva was accidentally destroyed.

Larva *I*, isolated January 17th, contained an embryo extending from the fifth to the eleventh body segments of the mother larva. The next day four presumably polar cells were recognized at the posterior extremity. There were no evident streaks in the embryo. On the 19th one very large aggregation of unusually dark cells was observed just before the posterior extremity, the opposite extremity being largely filled with globular ectodermal cells, especially abundant on one side. The following day a distinct tract of darker tissue was observed on one side of the embryo, extending from its anterior third to its posterior fifth and representing approximately the area occupied by the mesodermal tissue. January 21st the embryo extended from the fifth to the anterior margin of the thirteenth segment of the mother larva. There was a distinct fold of ectodermal tissue, presumably in the region of the

eighth to the twelfth embryonic segments, extending a little over half the width of the embryo. Posteriorly there were several large, globose, nucleated cells, presumably polar cells, while at the opposite end there was a considerable mass of large cells having a diameter of one-fourth to one-third that of the embryo. Two days later the posterior extremity of the embryo contained a mass of large-celled tissue in which were several larger, indistinct, presumably polar cells. The large, glistening mesodermal tissue was observed in the region of the ninth to the twelfth segments, while the sublateral developing adipose tissue was seen on either side. This condition is well shown in a photograph taken the following day (pl. 35, fig. 2), at which time the embryo exhibited distinct movements. The rather well formed head was colorless and moved from side to side. Streaming of the body contents was observed though the fat bodies occupied a comparatively small space on either side. The fine-celled, slender, malpighian tubes were noted. The posterior extremity had well developed lobes. On the 25th the median mass of mesodermal tissue had begun to contract, the developing adipose tissue increasing considerably. Two days later the head was well developed; the ocular spot black; the salivary glands were recognized; the malpighian tubes were distinct, while the mesodermal tissue extended approximately from the tenth to the twelfth segments and had a width only about one-fourth the diameter of the embryo. The following day the embryo escaped from the mother larva.

Larva *N* was a small, yellow larva separated January 30th and containing an embryo extending from the posterior third of the ninth to the posterior third of the eleventh segment of the mother larva. The embryo exhibited a distinct germinal strip extending from the anterior third to the posterior fourth and with a broad band of ectodermal tissue extending to one side and including approximately the middle of the embryo. The anterior extremity of the embryo is capped as it were with dark-celled tissue, while large yolk cells may be seen here and there in the germ plasma. This embryo was about as far advanced as the one illustrated on plate 32, figure 4. The next day there was a median germinal strip of lighter cells and on one side a layer of decidedly darker cells, much as shown in plate 30, figure 1. February 1st the two layers described above were more distinct and broader, the median lighter one being crowded a little to one side by the greater development and consequent breadth of the darker ectoderm, which latter extended al-

most to the middle of the embryo and from its anterior third to its posterior fourth. The anterior extremity of the embryo is characterized by irregular series of moderately large cells in the germ plasm. February 2d the median mesodermal tissue was crowded still further to one side by the darker ectoderm which now extends to the middle of the embryo and appears to have elongated somewhat. Both extremities of the embryo have retracted a little from the tip of the amniotic sac and are occupied by irregular series of large cells. The following day the mesoderm was crowded still further to one side by the darker ectoderm. At the anterior extremity of the embryo there was a mass of rather dark, fine-celled tissue, possibly the corpus luteum and apparently separating by fission, while the greater portion appears to be composed of globular, highly refractive cells grouped much as at the posterior extremity, which latter is narrowly margined by rather large, highly refractive, indistinctly grouped cells, one or more being unusually large. February 4th there was a distinct clear space in each extremity of the amniotic sac. The anterior extremity of the embryo is distinctly lobed, the broader, less produced portion capped with a mass of large, refractive cells, the small protuberant lobe composed of fine tissue. The posterior extremity of the embryo is distinctly bilobed. Unfortunately the numerous changes observed in this embryo from this point on at least appear to be abnormal, since the embryo disintegrated February 9th, though pulsations in the mother larva continued normally till the 15th.

A very interesting embryo was discovered in larva *Y* February 6th. The embryo extended from the seventh to the eighth abdominal segments and had a length equal to nearly twice the diameter of the mother larva. It was narrowly elliptical, with a length approximately three times its diameter. The polar cells, though visible, were not so conspicuous as in the younger embryo illustrated on plate 30, figures 2 and 3. This embryo is composed of nearly uniformly developed, rather transparent, semicuboidal, ectodermal cells. At the anterior extremity there was a slight thickening, apparently the much reduced cells of the corpus luteum. The median portion was occupied by a rather broad streak of dark, granular cells bordered on either side, including the extremities, by lighter, smaller-celled tissue. The mother larva was alive, as evidenced by distinct pulsations. The following day a distinct though small cap of cells was observed at the anterior extremity of the embryo. At the posterior third of the embryo

there was a distinct constriction, almost a division, the tissues adjacent thereto being markedly larger and darker, while at the posterior extremity there was a distinct lobe occupying about two-thirds the width of the embryo. February 8th there was a shrinking from both extremities of the amniotic sac, and other changes which are not described in detail, since they appeared to be preliminary to disintegration the next day, though the mother larva continued alive until the 15th.

An active, moderate-sized, white larva was isolated February 27th and its granular ovaries were seen partially to divide into irregular lobes, the one at the posterior extremity of the left developing into an ovum larger than the remainder of the ovary. The anterior third of the ovum was filled with darker, granular matter, while the remainder consisted of clear plasm containing about seven large, nucleated cells. This ovum increased in size until it was larger than the remainder of the ovary in which it originated, gradually separating therefrom by fission and shortly developing into a small embryo in the morula stage with distinct polar cells much as is illustrated on plate 30, figures 2 and 3.

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EXPLANATION OF PLATES

PLATE 1

105

Codling moth work

Sprayed but once

1*a* Picked fruit: 135 sound, 13 wormy apples
1*c* Picked fruit: 382 sound, 27 wormy apples
1*d* Picked fruit: 563 sound, 30 wormy apples

Plate 1

Sprayed apples

PLATE 2

Codling moth work

Sprayed twice

2a Picked fruit: 414 sound, 27 wormy apples
2b Picked fruit: 347 sound, 15 wormy apples
2d Picked fruit: 941 sound, 13 wormy apples

Plate 2

Sprayed apples

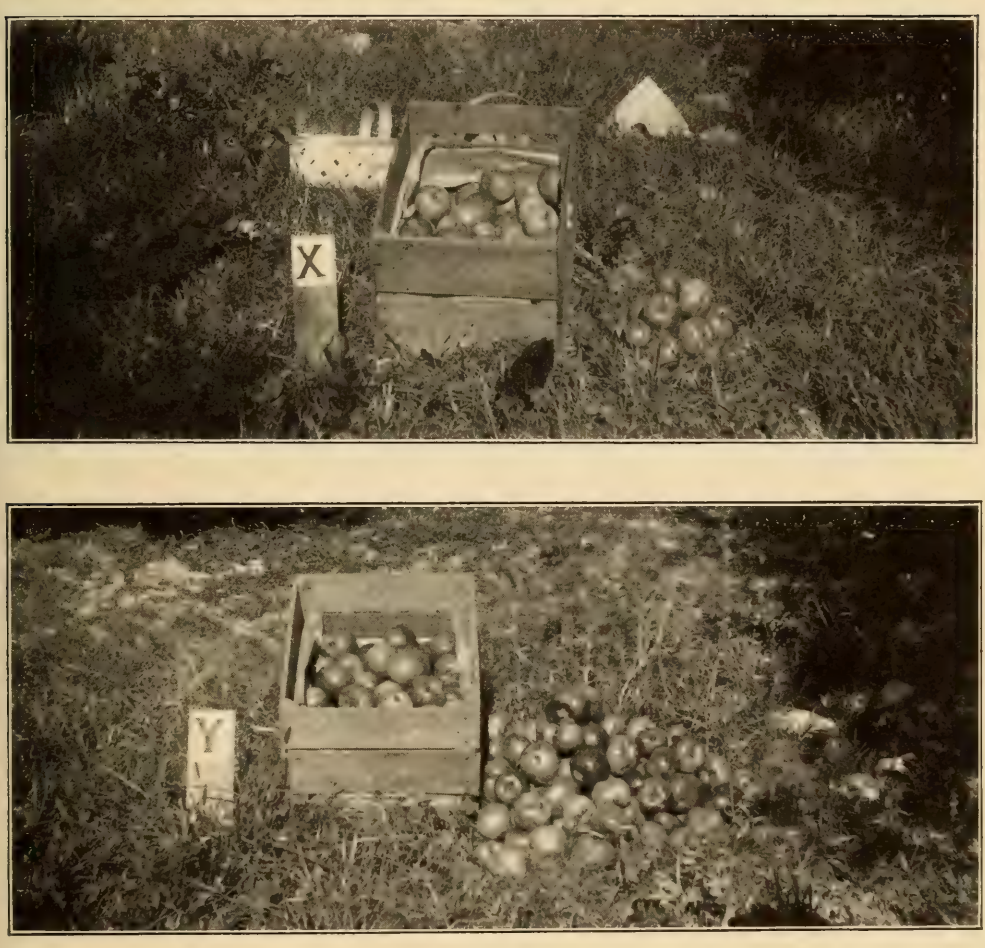
PLATE 3

Codling moth work

Unsprayed or check trees

X Picked fruit: 86 sound, 69 wormy apples
Y Picked fruit: 97 sound, 233 wormy apples

Plate 3



Unsprayed apples

PLATE 4

III

Codling moth work

Sprayed but once

1*b* Picked fruit: 1394 sound, 117 wormy apples
1*d* Picked fruit: 703 sound, 82 wormy apples
1*f* Picked fruit: 596 sound, 66 wormy apples

Plate 4

Sprayed apples

PLATE 5

Codling moth work

Sprayed twice

2a Picked fruit: 658 sound, 51 wormy apples
2b Picked fruit: 1501 sound, 88 wormy apples
2c Picked fruit: 760 sound, 52 wormy apples

Plate 5

Sprayed apples

PLATE 6

Codling moth work

One late spraying

3a Picked fruit: 392 sound, 198 wormy apples
3d Picked fruit: 830 sound, 128 wormy apples
3e Picked fruit: 467 sound, 163 wormy apples

Plate 6

Sprayed apples

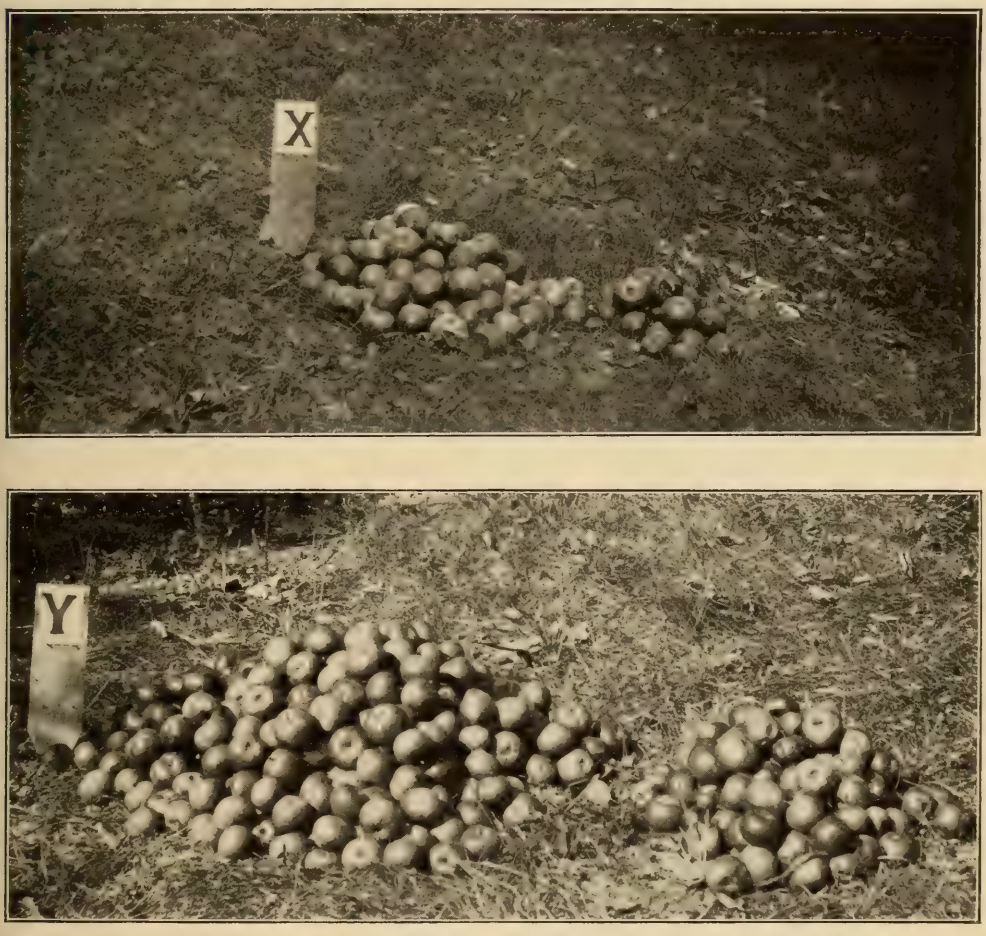
PLATE 7

Codling moth work

Unsprayed or check trees

X Picked fruit: 120 sound, 47 wormy apples
Y Picked fruit: 317 sound, 325 wormy apples

Plate 7



Unsprayed apples

PLATE 8

Codling moth work

Upper figure, Wealthy tree in series 3

Lower figure, Mackintosh tree in series 3, also showing yield of tree 2Y; 125 sound, 250 wormy apples

1

2

Experimental trees

PLATE 9

Codling moth work

Apples showing the characteristic end wormy infestation, also one which has been entered at a slight depression by a larva of the second brood

Wormy apples

PLATE 10

Codling moth work

1 Baldwin showing a moderate amount of bordeaux injury
2 Work of Tortricid followed by codling moth injury

Russeted and wormy fruit

PLATE 11

Codling moth work

Two apples showing work of Tortricid

1 The operations of the insect about the blossom end
2 Its feeding near the end and upon the side of the apple

Work of Tortricid on apples

PLATE 12

Codling moth work

1 Baldwin showing a moderate amount of injury by bordeaux mixture
2 Baldwin with more severe injury and incipient cracking, a codling moth entrance in the middle of a crack

Russeting and codling moth injury

PLATE 13

Codling moth work

1 Asymmetrical Ben Davis with one side badly deformed, probably fr
injury by bordeaux mixture

2 Another apple badly injured though not deformed by bordeaux mixtu

Russeted fruit

PLATE 14

131

4a

Codling moth work

Badly checked apples on unsprayed trees. Such crevices are favorite point for entry by codling moth.

Russeted and checked fruit

PLATE 15

Psyllopsis fraxinicola Först.

Distorted ash leaves, showing work of this species

Plate 15

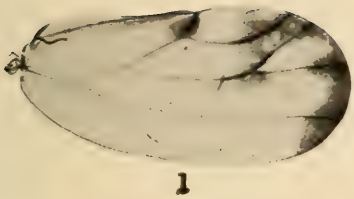
Work of ash psylla

PLATE 16

Psyllopsis fraxinicola Först.

1 Anterior wing, male. x 15
2 Posterior wing, male. x 15
3 Apex of male abdomen, showing genitalia. x 20
4 Apex of female abdomen, showing ovipositor and accessory organs. x 20
5 Head. x 15
6 Antenna, portion of anterior leg and part of rostrum of female. x 30

Plate 16

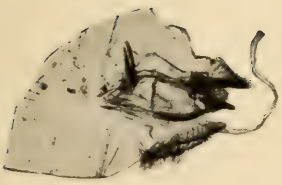


1

2

3

5



4

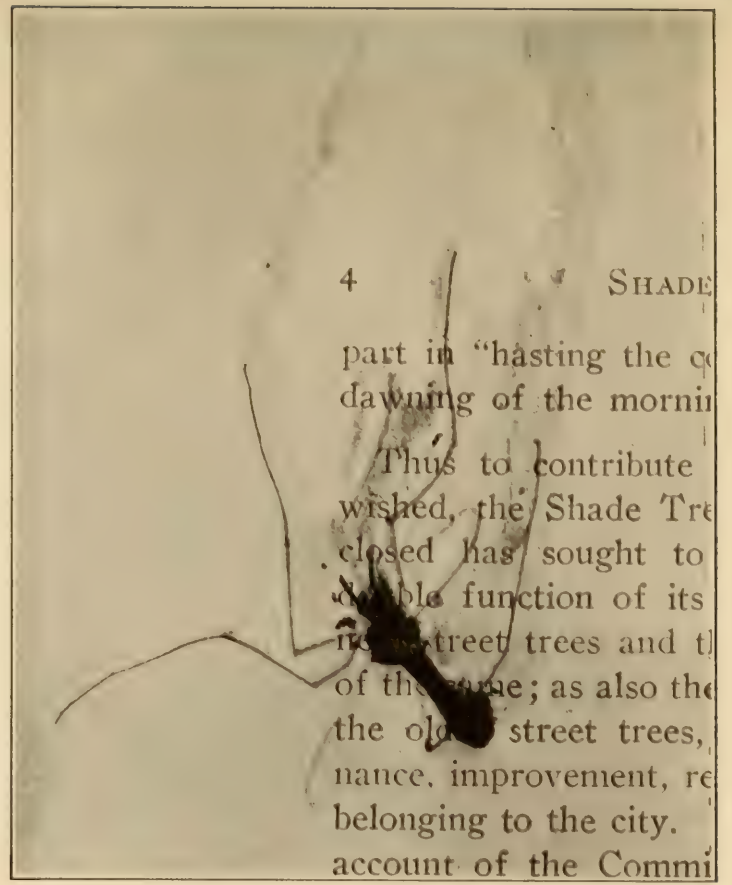
6

Ash psylla

PLATE 17

1 Gall of Chermes cooleyi Gill. on blue spruce, natural size
2 A portion of a printed page showing a crane fly which had been pressed into the paper in the calendering process. Natural size

1



2

Spruce gall and crane fly

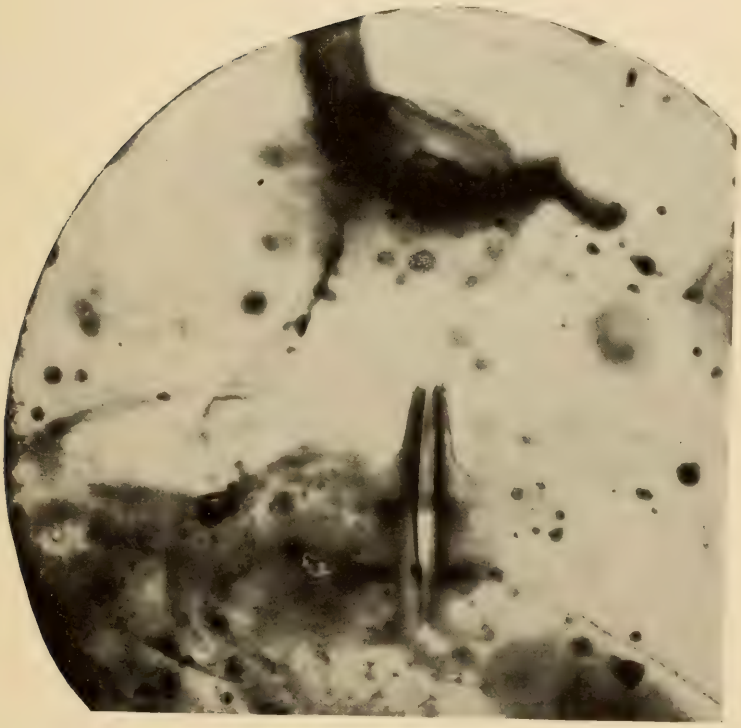
PLATE 18

Chermes piceae Ratz.

1 Ventral aspect of female. x 35
2 Posterior extremity showing ovipositor. x 200

Plate 18

1



2

Silver fir aphid

PLATE 19

Camponotus herculeanus Linn.

Work of carpenter ant in poplar

Plate 19

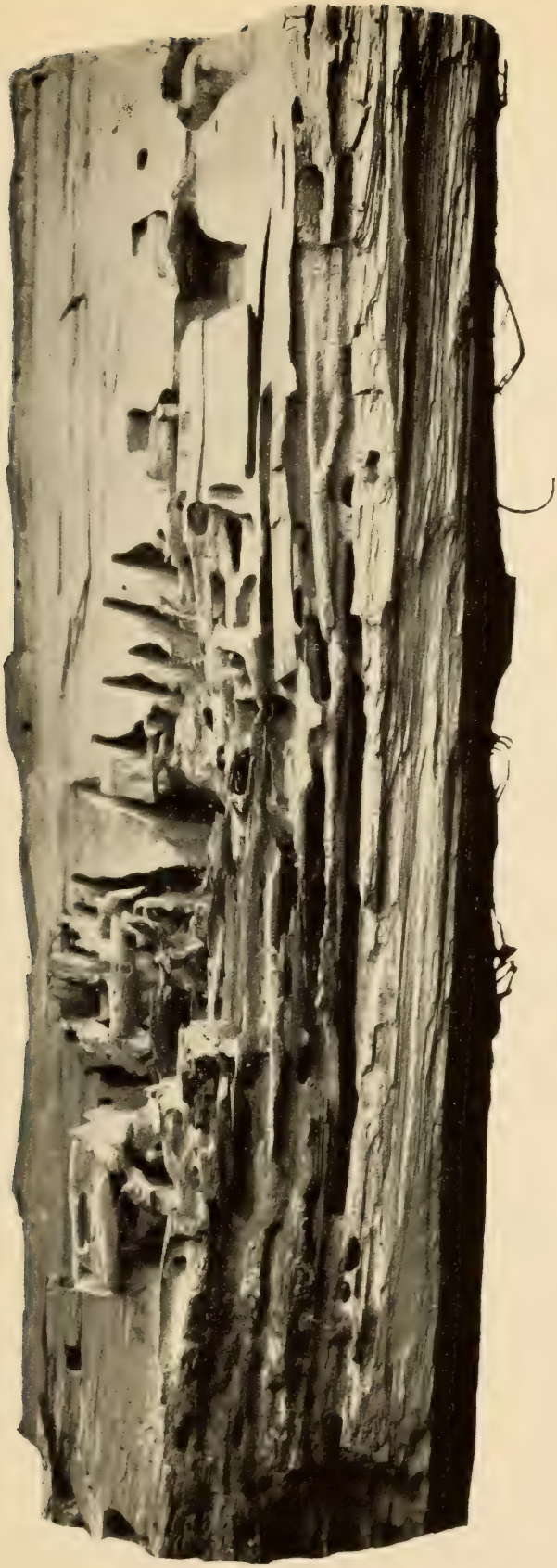
Work of carpenter ant

PLATE 20

Camponotus herculeanus Linn.

Work of carpenter ant in poplar; another view

Plate 20



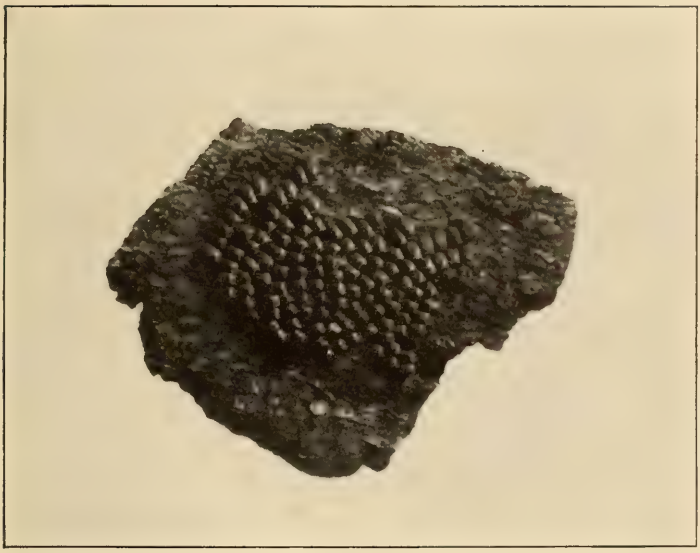
Work of carpenter ant

PLATE 21

Snow-white linden moth

1 Snow-white linden moth; eggs, slightly enlarged
2 Adult moths

Plate 21



1

2

Snow-white linden moth

PLATE 22

Miastor ? americana Felt

1 Large, white, living larva chilled. Photographed by reflected light. x 50

Plate 22

Miastor larvae

PLATE 23

Miastor ? americana Felt

1 Mother larva containing a number of semitransparent embryos. Note cells well filled with adipose tissue. x 50. By reflected light

2 Mother larva containing several semitransparent embryos. Note comparatively few large cells filled with adipose tissue. x 50. By reflected light

Plate 23

1 2

Miastor larvae containing embryos

PLATE 24

Miastor ? americana Felt

1 Mother larva containing several nearly developed embryos. x 50

2 Mother larva containing two nearly developed embryos. Note columns of large cells. x 50

Plate 24

1

2

Embryos in Miastor larvae

PLATE 25

153

Miastor ? americana Felt

Posterior extremity of a large mother larva filled with numerous embryos, one lying free across the broken end. x 100

Plate 25

Miastor embryos

PLATE 26

Miastor ? americana Felt

1 Portion of chip showing a number of Miastor larvæ. x 20

2 Head and anterior body segments of larva, showing the shape of the head, with the anterior third fuscous, the short, diverging antennae, the ocular spot and the lobed brain. x 120

3 Posterior extremity of larva, showing cuticular processes at its apex. x 50

Plate 26

1

2

3

Miastor larvae

PLATE 27

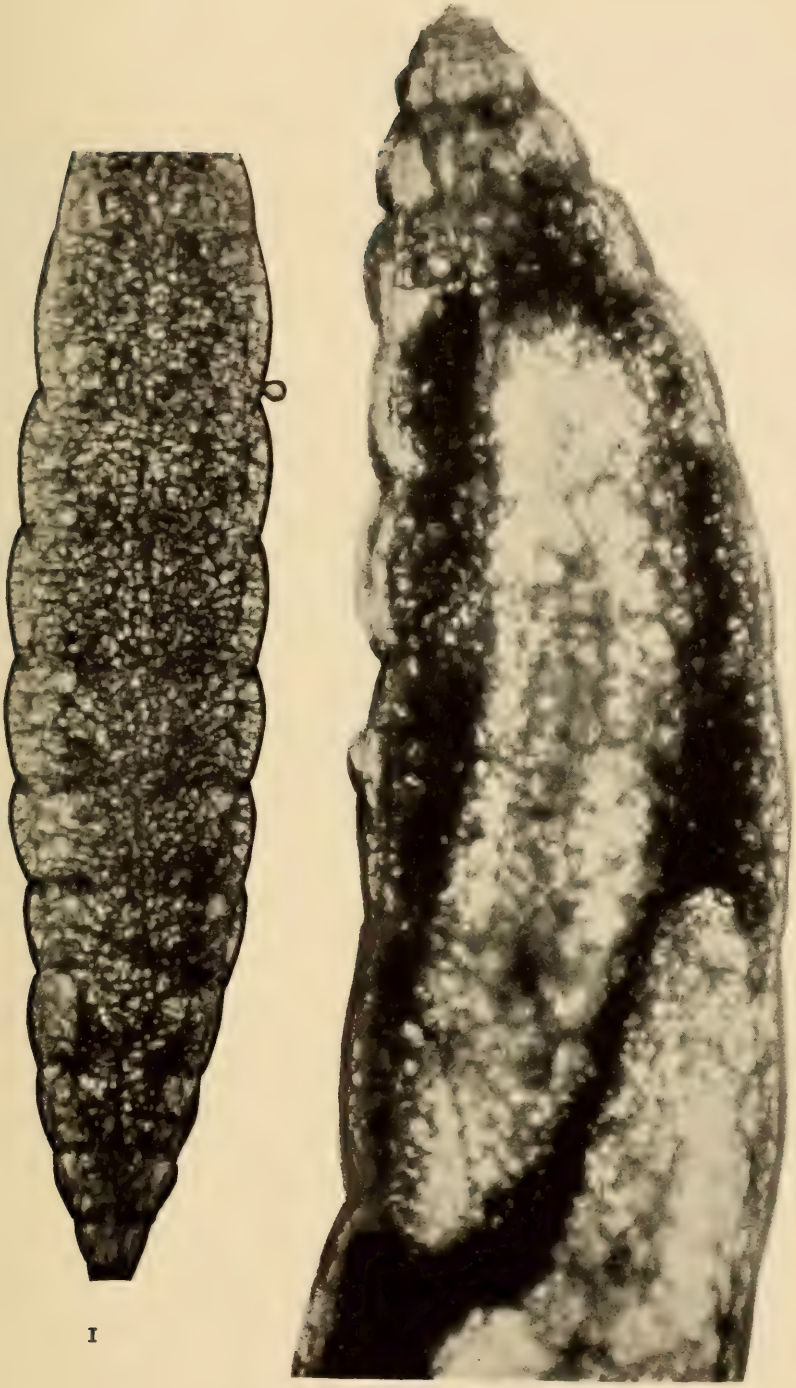
157

Miastor ? americana Felt

1 Mother larva filled with partly broken down adipose tissue, the embry concealed beneath. x 50

2 Embryo in mother larva, showing general outline and an indistinct segme tation along the germinal streak. x 120

Plate 27



1

2

Miastor larvae

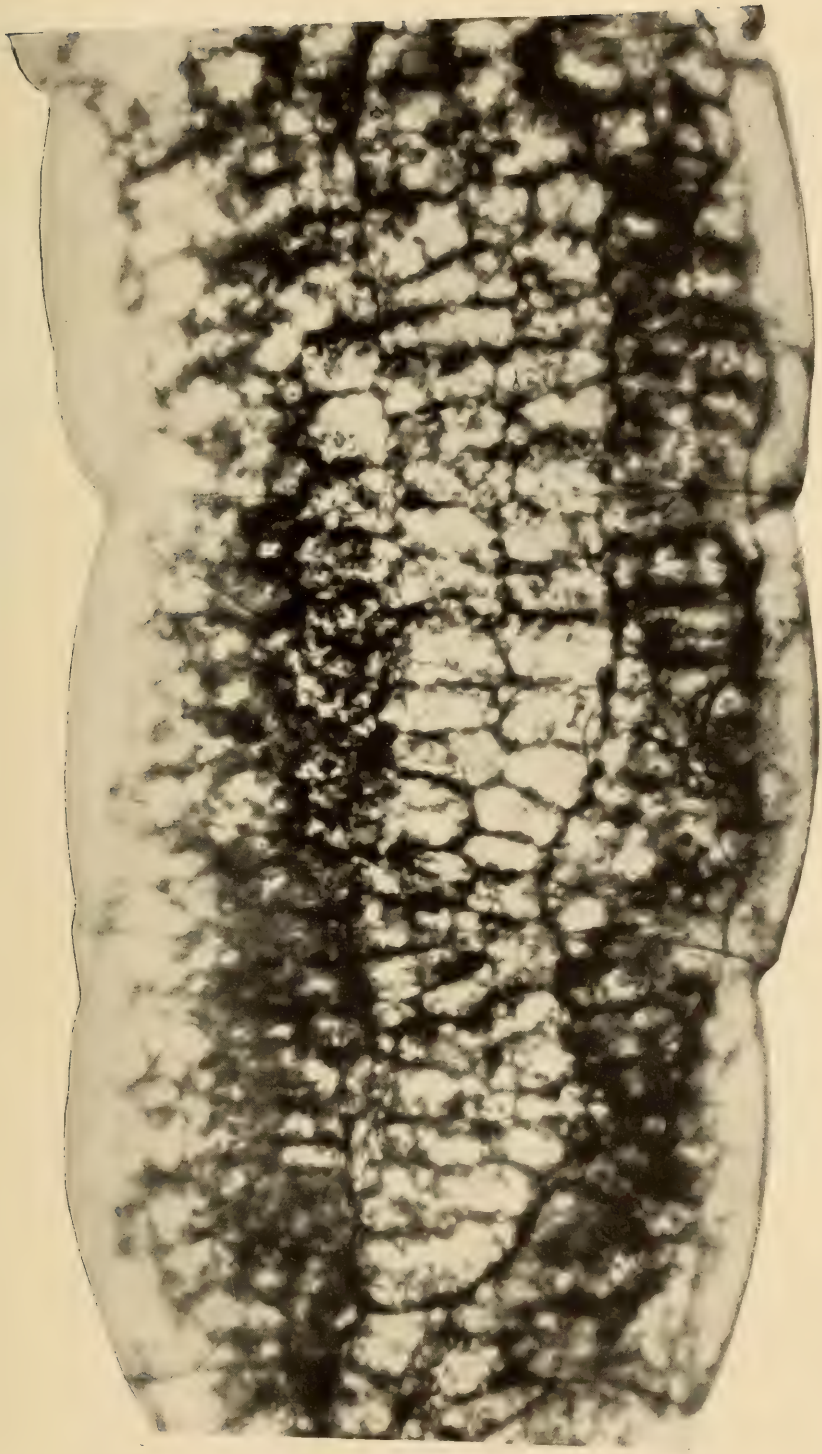
PLATE 28

159

Miastor ? americana Felt

Three segments of a large, white mother larva, showing series of cuboid cells. x 200

Plate 28



Portion of Miastor larvae

PLATE 29

161

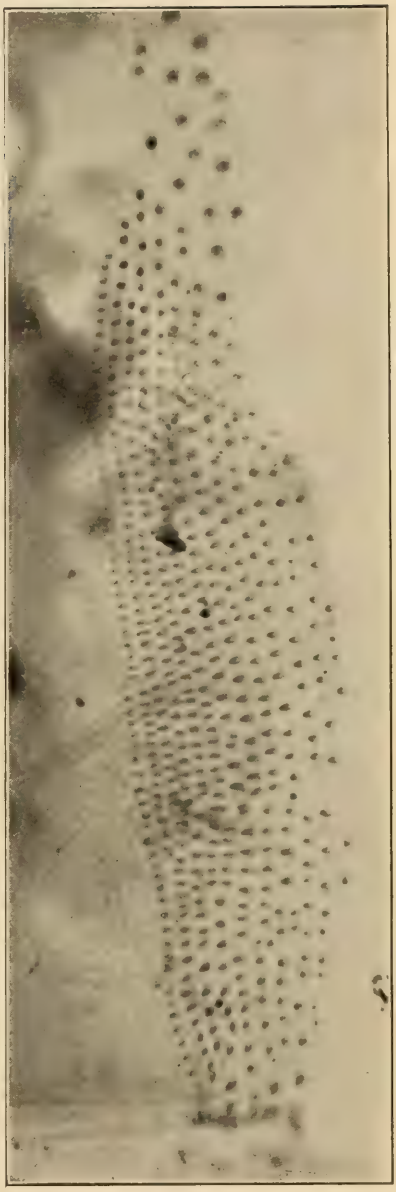
Miastor ? americana Felt

1 Ovary of mother larva. Note the large-celled, oval mass of tissue near th discolored area. x 325

2 Portion of a band of spines. x 325

Plate 29

1



Miastor larvae 2

PLATE 30

163

5

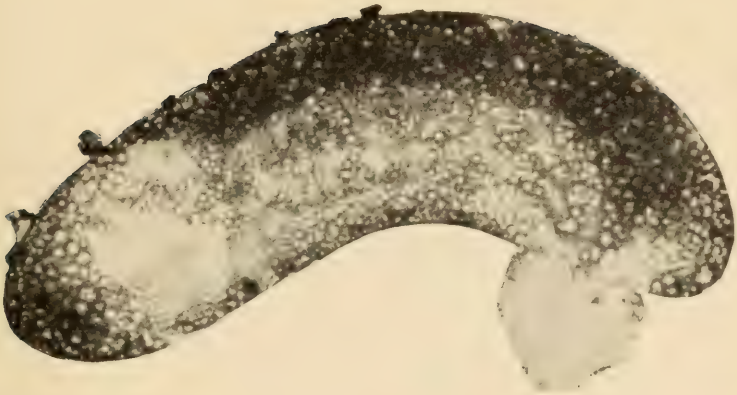
Miastor ? americana Felt

1 Young embryo dissected from a large mother larva and showing a darker strip of ectoderm, a lighter mesodermal area and a dark mass of tissue at the anterior extremity toward the left. x 100

2 Young living embryo lying mostly in the ninth segment of a small, yellowish mother larva. Note the large polar cells at the lower posterior extremity. x 200

3 The same, more enlarged. x 400

Plate 30



1

2

Miastor embryos 3

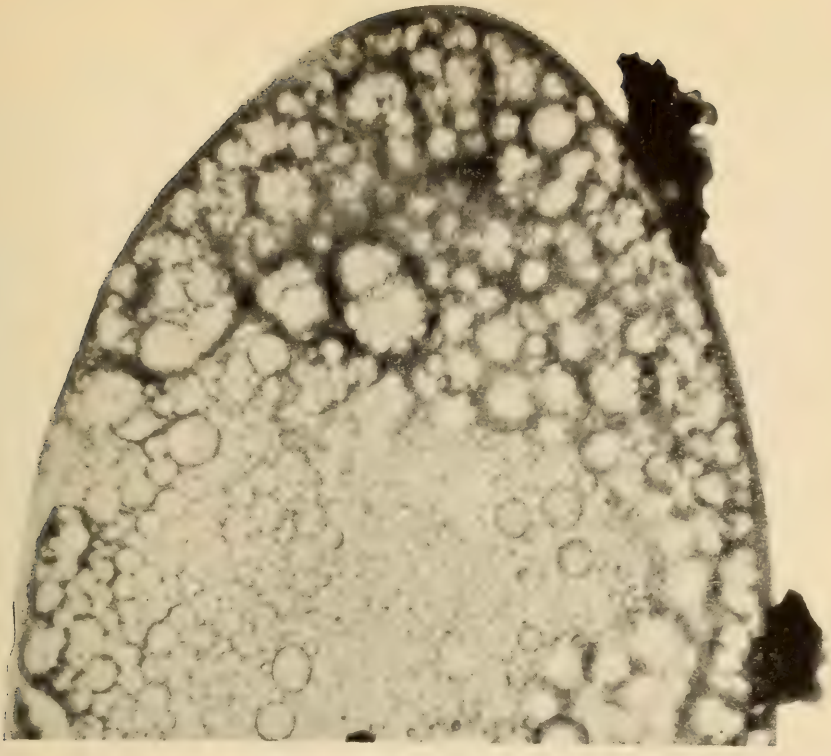
PLATE 31

Miastor ? americana Felt

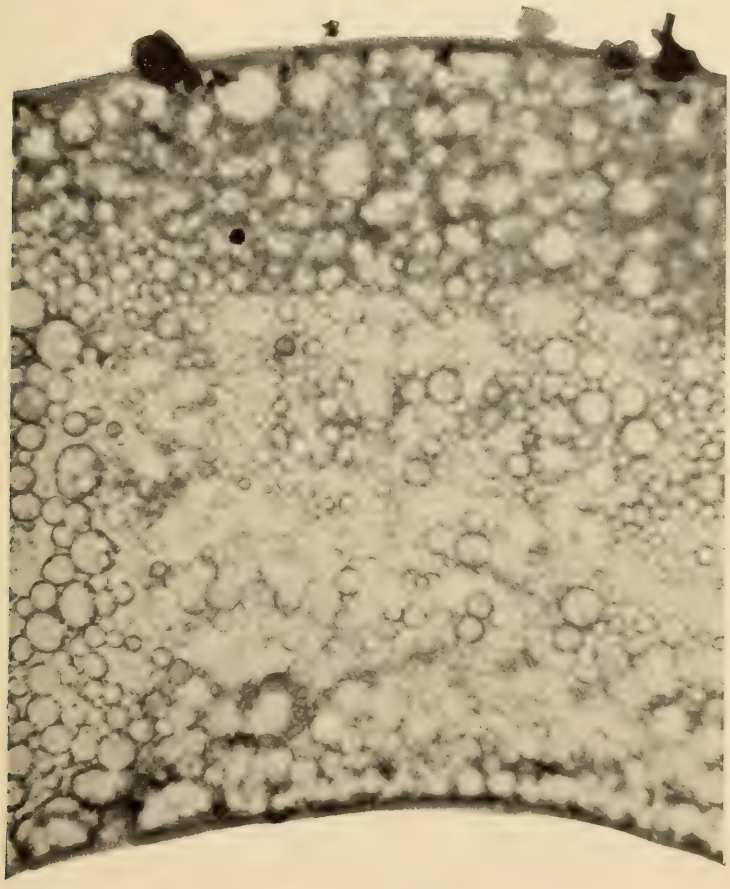
1 Anterior extremity of embryo illustrated in figure 1 of the preceding plate. x 300

2 Middle portion of same embryo. x 300

Plate 31



1



2

Miastor embryos

PLATE 32

167

Miastor ? americana Felt

1 Living embryo within a small, yellowish larva. Note the distinct germinal streak with its broad projection to one side near the anterior third, and the cephalic cap of fuscous cells. x 100

2 The same embryo photographed 24 hours later and showing some change. This photograph was relatively not as good as the first. x 100

3 The same embryo several days later showing the condition after disintegration has begun. x 100

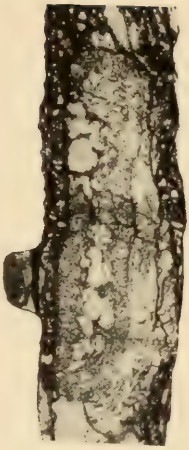
4 A larger embryo in a small, yellow mother larva extending from her fifth to eighth body segments. Note the great extension of the ectoderm from about the anterior fourth to the posterior fifth, and the cephalic cap of dark cells. x 100

5 Empty skin of a portion of a mother larva. The irregular, dark, longitudinal lines represent tracheae while the transverse fuscous bands are spines on the segments. x 100

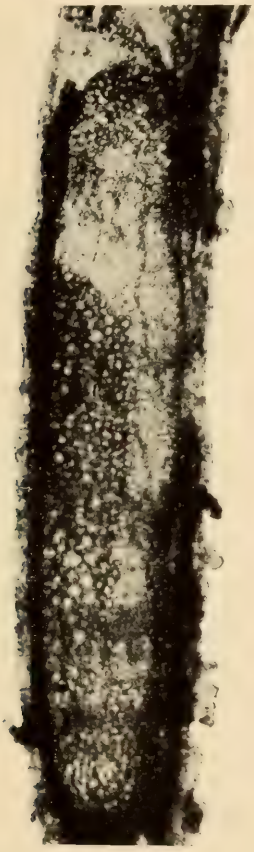
Plate 32

1

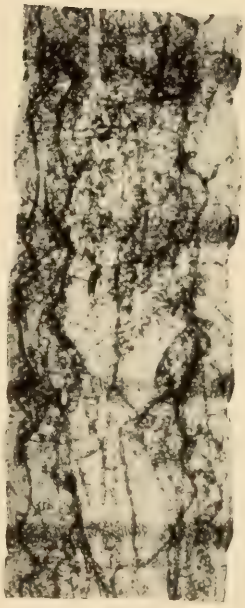
2



3



4



5

Miastor embryos

PLATE 33

169

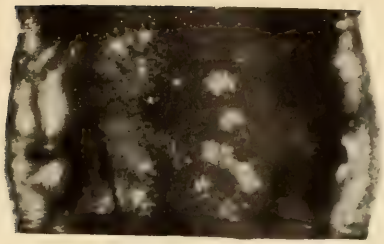
Miastor ? americana Felt

1 A portion of a segment of the larva illustrated on plate 35, figure 1 showing the character of the large-celled median mass of mesoderm. x 200

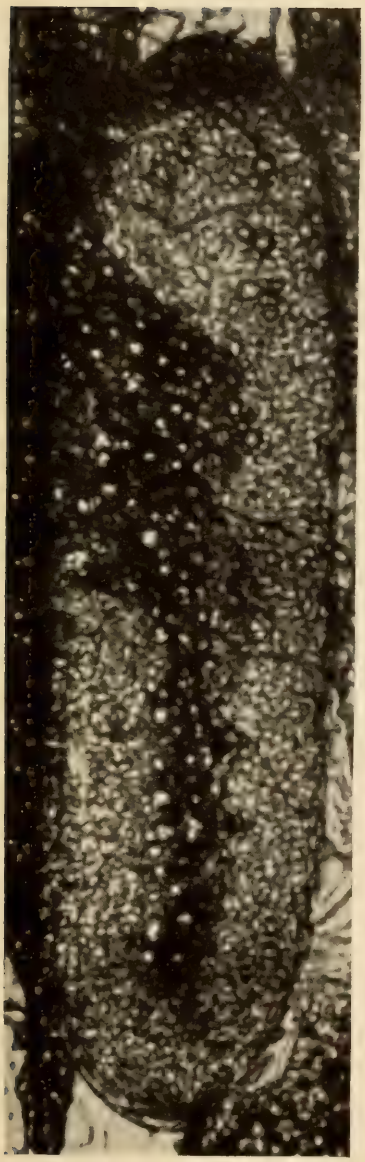
2 Embryo illustrated on plate 32, figure 1. x 300

3 Enlargement of same embryo from photograph made the following day. x 300

Plate 33



1



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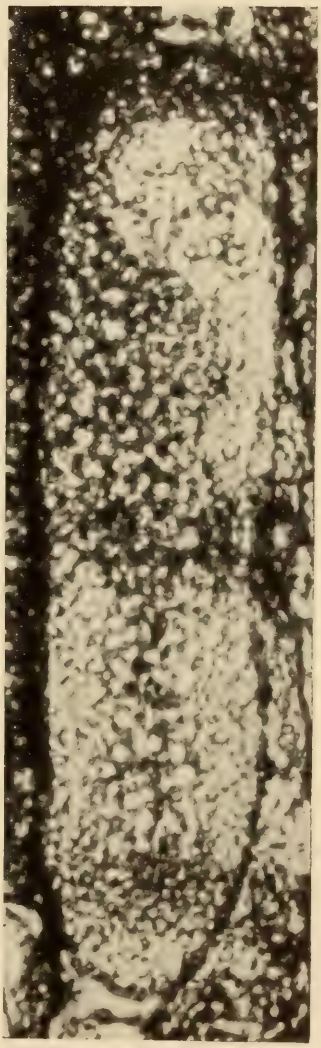


3

Miastor embryos

PLATE 34

171

Miastor ? americana Felt

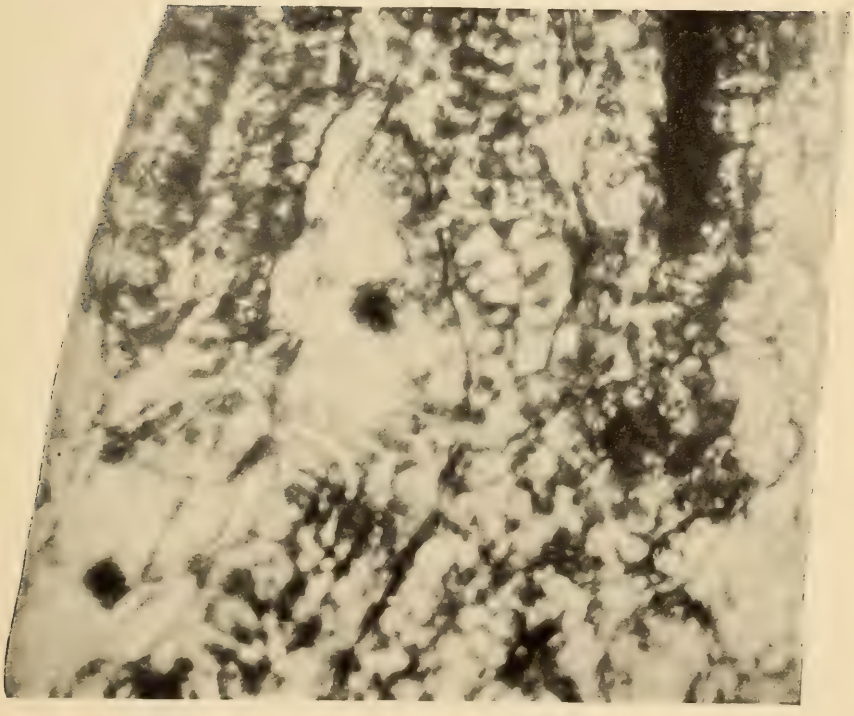
1 Small, yellowish mother larva containing an embryo extending from the fourth to the eleventh body segments and illustrating an early stage in the development of the mesoderm and adipose tissue. x 75

2 Small, somewhat shrunken, yellowish mother larva containing a nearly fully developed embryo, the fuscous anterior portion of the head and the black ocular spot showing distinctly in her posterior (lower) body segments. x 75

3 Portion of a large, white mother larva packed with numerous embryos. The two conspicuous black spots near the middle of lighter areas represent well developed ocular spots of embryos nearly ready to escape. This mother larva contained about 10 such embryos, the heads of three at least, being included in the portion illustrated. x 200

1

2



3
Miastor embryos

PLATE 35

Miastor ? americana Felt

1 Mother larva containing an embryo extending from about the fifth to the tenth body segments and showing an early stage in the development of the mesodermal tissue. x 100. A portion of the latter more enlarged as illustrated on plate 33, figure 1.

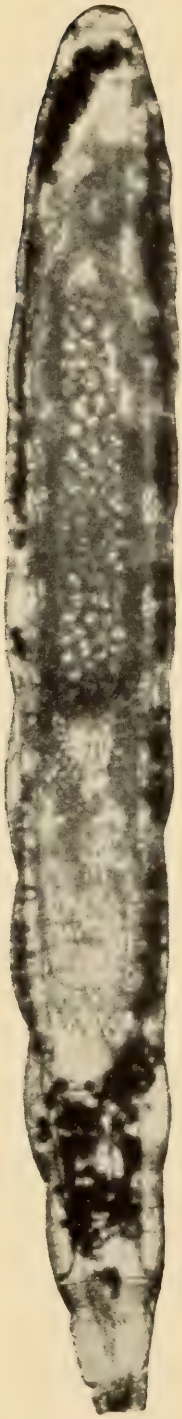
2 Small, yellow mother larva containing an embryo extending from the fourth to the twelfth segments and showing in the posterior part of the embryo a conspicuous mass of large-celled mesodermal tissue with distinctly rounded extremities. x 100

3 Small, yellow mother larva containing a nearly developed embryo showing the three-rowed condition due to an increase in the embryonic adipose tissue and a correlated decrease in the mesoderm. x 100

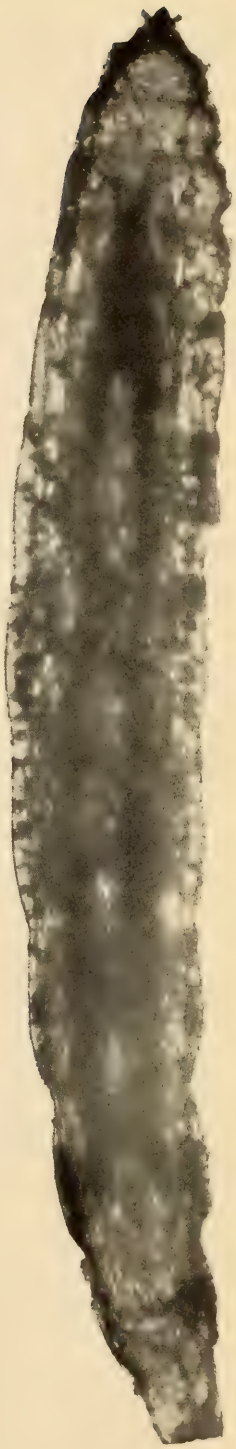
All on this plate are arranged with the head of the mother larva up, the anterior extremity of the embryo being toward the bottom of the plate.

Plate 35

1



2



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New York State Education Department

New York State Museum

JOHN M. CLARKE, Director

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12 "	61 Economic Geology	110 "
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14 Geology	63 Paleontology	112 Economic Geology
15 Economic Geology	64 Entomology	113 Archeology
16 Archeology	65 Paleontology	114 Paleontology
17 Economic Geology	66 Miscellaneous	115 Geology
18 Archeology	67 Botany	116 Botany
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